Chapter 3. Affected Environment and Environmental Consequences

This Chapter summarizes the physical, biological, social, and economic environments of the project area and the effects of implementing each alternative on that environment. It also presents the scientific and analytical basis for the comparison of alternatives presented in the alternatives chapter.

3.1 Silviculture – Forest Vegetation

Introduction

This section describes the vegetation resources in the Como Forest Health project area in terms of:

- Existing forest condition and desired forest conditions
- Treatments to achieve desired conditions
- The direct, indirect, and cumulative effects of the proposed treatments on forest conditions.

In support of the above topics, the regulatory framework that guides forest management, specifically timber harvest is described. Also, the disturbance mechanisms that modify forest vegetation conditions are described.

3.1.1 Regulatory Framework

Requirements for project or activity planning are established in the Forest Service Directives System. Required project level NFMA consistency findings are described in FSM 1900, Chapter 1920, Section 1921.12-Vegetation Management Requirements and in FSH 1909.12, Chapter 20, Section 29-Application of Plan to Project. Forest Service Handbook 1909.12, Chapter 60, Section 61 describes Vegetation Management Requirements at the Project Level.

3.1.1.1 National Forest Management Act

1921.12a-Timber Management Requirements

The minimum specific management requirements for projects or activities that must be met in carrying out projects and activities for the National Forest System (NFS) are set forth in this section. Under 16 U.S.C. 1604 (g) (3) (E), a Responsible Official may authorize site-specific projects and activities to harvest timber on NFS lands only where:

1. Project activities will not irreversibly damage soil, slope, or other watershed conditions. Response: Refer to the soils and watershed sections.
2. There is assurance that the lands can be adequately restocked within five years after final regeneration harvest (FSM 1921.12g). Response: Stands within the project area that have had regeneration harvests from the 1950s to the present have been certified and are adequately stocked. In this project, we are proposing stand regeneration harvest in group selection harvests. Stands that are designed for group selection would either regenerate naturally or artificially regenerated with planting to appropriate stocking levels within five years.

3. Streams, streambanks, shorelines, lakes, wetlands, and other bodies of water are protected from detrimental changes in water temperatures, blockages of watercourses, and deposits of sediment where harvests are likely to seriously and adversely affect water conditions or fish habitat. Response: Refer to the soils and watershed sections.
4. The harvesting system to be used is not selected primarily because it will give the greatest dollar return or the greatest unit output of timber. Response: The harvesting systems used in this project were selected based on site-specific resource needs and not selected primarily to give the greatest dollar return or the greatest output of timber.

A Responsible Official may authorize projects and activities on NFS lands using cutting methods, such as clearcutting, seed tree cutting, shelterwood cutting, and other cuts designed to regenerate an even-aged stand of timber, only where:

1. For clearcutting, it is the optimum method; or where seed tree, shelterwood, and other cuts are determined to be appropriate to meeting the objectives and requirements of the relevant plan (16 U.S.C. 1604 (g)(3)(F)(i)). Response: The group-selection cutting units create defined gaps in the forest canopy. Referred to as “gap-phase dynamics,” openings are created without departing from a fully stocked stand. The openings provide microenvironments within the unit for regeneration of tree species from the spectrum of local seed sources.
2. The interdisciplinary review has been completed and the potential environmental, biological, aesthetic, engineering, and economic impacts have been assessed on each advertised sale area and the cutting methods are consistent with the multiple use of the general area (16 U.S.C. 1604 (g)(3)(F)(ii)). Response: Refer to the respective resource sections of this analysis.
3. Cut blocks, patches, or strips are shaped and blended to the extent practicable with the natural terrain (16 U.S.C. 1604 (g) (3) (F) (iii)). Response: Small patch openings created from the group-selection harvests will be blended and feathered to avoid straight edges. These groups are not prescribed to be uniform in size, shape, or arrangement.
4. Cuts are carried out according to the maximum size limit requirements for areas to be cut during one harvest operation (FSM 1921.12e). Response: The small openings are well under the 40-acre limit with the largest opening proposed at 5 acres.
5. Timber cuts are carried out in a manner consistent with the protection of soil, watershed, fish, wildlife, recreation, esthetic resources, cultural and historic resources, and the regeneration of timber resources. Response: Refer to the respective resource sections of this analysis.
6. Forest stands are harvested according to requirements for culmination of mean annual increment of growth (16 U.S.C. 1604 (m); FSM 1921.12f; FSH 1909.12, chi. 61.3). Response: This project proposes primarily intermediate and uneven-aged harvests and CMAI requirements are not required. There is no planned regeneration harvest in which CMAI must be met.

Suitability for Timber Production

Lands identified as generally suitable for timber harvest and timber production are designated in the Forest Plan. These lands are validated at the project level (36 CFR 219.12(a) (2) (D) (ii)). Project level suitability determinations are made during silviculture diagnosis and soil review. As a pre-cursor to the silvicultural diagnosis process, stand examinations are conducted to determine existing stand conditions, and suitability for timber production for each stand. Final suitability determinations for lands proposed for commercial timber harvest would be documented in a site-specific silviculture diagnosis and prescription, prepared or reviewed by a certified Silviculturist, in coordination with the Soil Scientist.

In addition, the Forest Plan (1987) initially determined Douglas-fir/ninebark habitat types as unsuitable from the regeneration standpoint. The assumption was that stands of Douglas-fir heavily infected with dwarf mistletoe would require clearcuts for regeneration purposes; however, the soils were too rocky to hand plant. The alternative to apply a shelterwood system and rely on natural regeneration would not be biologically acceptable since Douglas-fir regeneration, if adequate, would be infected by the Douglas-fir overstory (Bitterroot National Forest 1981). The Forest Plan Monitoring and Evaluation Report, fiscal year 2003 (USDA Forest Service 2003b) states that previous monitoring of these Douglas-fir/ninebark habitat types has determined that these sites should actually be classified as suitable.

Stands proposed for harvest treatment in Como Forest Health Project were examined for suitability in accordance with 36 CFR 219.12(a) (2) (D) (ii). Units were found to be suitable for timber management based upon the following:

- Meet the definition of forestland as described in 36 CFR 219.16.
- Technological feasibility exists to ensure soil productivity and watershed protection. All sites considered for treatment would use established harvesting and site preparation methods. In combination with resource protection standards in the Forest Plan, applicable Best Management Practices and INFISH would be sufficient to protect soil and water resource values.
- None of the stands considered for harvest have been withdrawn from timber production as specified in 36 CFR 219.12(2) (A) (B).

3.1.1.2 Bitterroot National Forest Plan Direction

The Bitterroot National Forest Plan (USDA 1987) sets out basic management direction and guides natural resource management activities. Forest plan goals and objectives are described on pages II-2 to II-7 and Management Area (MAs) standards are listed between pages III-3 and III-80. Goals and objectives directly applicable to vegetation include:

- Provide saw-timber and other wood products to sustain a viable economy, including firewood for personal and commercial use.
- Provide an economically efficient timber sale program.
- Maintain forest stands so that pest caused losses are reduced to acceptable levels.
- Maintain vegetative diversity on land where timber production is a goal of management.
- Convert high-risk or insect and disease infected stands to young, healthy stands.
- Provide optimal habitat on elk winter range.

- Provide for resource protection and fire use necessary to protect, maintain, and enhance resource values.
- Prescribe treatments that will utilize integrated pest management strategies and treatments that reduce long-term losses due to insects and disease.

The Como Forest Health project area contains MAs 1, 2, 3a, 3b, and 3c. Proposed activities are consistent with MA goals. Commercial timber harvest is proposed only in areas defined as suitable for timber management under the Bitterroot National Forest Plan. Except where site-specific Forest Plan Amendments are proposed, all treatments are designed to meet Forest Plan Standards and Guidelines.

3.1.2 Affected Environment

Vegetation is described relative to the processes that shaped its evolution and in terms of its attributes, composition, and structure. Describing trends and the wide range of vegetation conditions that result from historical processes provides the context to evaluate current conditions. Desired stand conditions are based on the function of ecological processes as affected by management activities.

3.1.2.1 Existing Condition

Vegetation Response Unit

Assessments that emphasize ecosystem-based management focus on strategies for sustaining natural processes and promoting long-term forest health while producing a sustainable flow of goods and services for public needs. This strategy requires an understanding of ecosystem function, composition, and the ecological processes that occur across the landscape. A healthy ecosystem is more resilient to natural and human-caused disturbances and less vulnerable to irretrievable losses.

The vegetation response unit (VRU) is the basic environmental stratification that relates repeatable landscapes to predictable ecological processes (USDA 1999). VRUs provide a way to interpret vegetation response to natural disturbance processes and enable a projection of future landscape conditions, and a foundation for landscape design. We can anticipate management opportunities to achieve desired conditions with an awareness and understanding of disturbance ecology, the role of disturbance in ecosystem dynamics, and the appreciation that ecosystems are constantly changing. To ignore disturbance or presume a steady-state condition compromises ecological resiliency.

VRUs are aggregations of land having similar biological capabilities and potentials for management with similar natural disturbance processes (USDA 1999). These units have similar patterns of potential plant communities (habitat types), soils, hydrologic functions, landforms, and natural disturbance processes. The Region 1 habitat groups (HG) (Pfister 1977) are the foundation for the VRU classification. The combination of climate, and geophysical and soil features create the habitat types indicative of the ecosystem. Habitat types are assigned to Fire Groups, which are based on the response of the dominant tree species to fire and the roles of these trees species during successional stages (Fischer and Bradley 1987). Also, the historic fire regime of a given ecosystem can be characterized by the average fire frequency, fire severity, and fire size (Perry 1994)

The interaction of these processes creates a vegetation mosaic across the landscape. Within a VRU, the proportion of age and size classes, successional stage, impacts of fire and disease change in response to disturbances. These changes directly or indirectly affect other aspects of the environment such as wildlife populations, biological diversity, insect pest populations, and potential fire behavior. VRUs have a natural scale of disturbance and management should mimic the scale of disturbance typical of the particular VRU.

Disturbance strongly influences individual species, natural communities and ecosystems, and is attributed to both natural and human causes (Landres et al. 1999). Fires historically burned in a range of sizes, intensities, and intervals throughout an area, which created a mix of stand ages, structures, and species. Insects, forest pathogens, and other disturbances also changed vegetation through time. This diversity of vegetation species, ages, and structures across the landscape is desirable because forest conditions are more resilient to disturbance. Not all vegetation size and age classes are subject to the same disturbance processes. Table 3.1- 1 displays the VRUs found within the Como Forest Health project area.

Vegetation Response Unit 1

Vegetation Response Unit 1 is a mix of forest and non-forest sites in a warm, dry setting. Where tree cover is present, it is composed of large ponderosa pine in open park-like stands with grassy understories and occasional shrubs. Trees tend to be clumped where soil development is adequate. Though the growing season is long, high solar exposure and shallow soils cause the soils to dry out early in the growing season. This lack of soil moisture creates harsh growing conditions in late summer and conditions of low vegetation productivity.

Table 3.1- 1: Vegetation Response Units (VRU's) within the Como Forest Health Project Area

Habitat Group	Old Growth Habitat[1]	Climate Modifier (Region 1 Groupings)	Vegetation Response Unit	Primary Fire Group Code	Area (acres)	Project area (%)	Proposed Treatment By VRU Alt2 (%)	Proposed Treatment By VRU Alt3 (%)	Proposed Treatment By VRU Alt4 (%)
HG 1	A	Warm and Dry	VRU 1	2, 4	268	5	3	3	2
HG 2	B, C	Moderately Warm and Dry	VRU 2	6	3,948	70	75	78	90
HG 3	G, C	Moderately Warm and moderately Dry	VRU 3	11	646	11	9	8	5
HG 4	D	Moderately Warm and Moist	VRU 4	11	36	1	1	0	0
HG 7	E	Cool and Moist	VRU 7	9	470	8	7	6	2
HG 9	H	Cool and Moderately Dry	VRU 9	8	277	5	5	5	1

Fuel loads tend to be light when compared to other fire groups. The most abundant surface fuel is cured grass. This is especially true for mature, open grown stands of ponderosa pine. Historically, natural fire frequencies in forests adjacent to grasslands were fairly high, according to numerous studies conducted in the ponderosa pine forest types in the western United States (Fisher Bradley 1987). These studies show fire was a frequent event, at intervals from 5 to 25 years. On the Bitterroot National Forest, Arno (1976) and Arno and Peterson (1983) reported fire frequency of 2 to 20 years. VRU 1 is approximately 5 percent of in the project area (Table 3.1- 1).

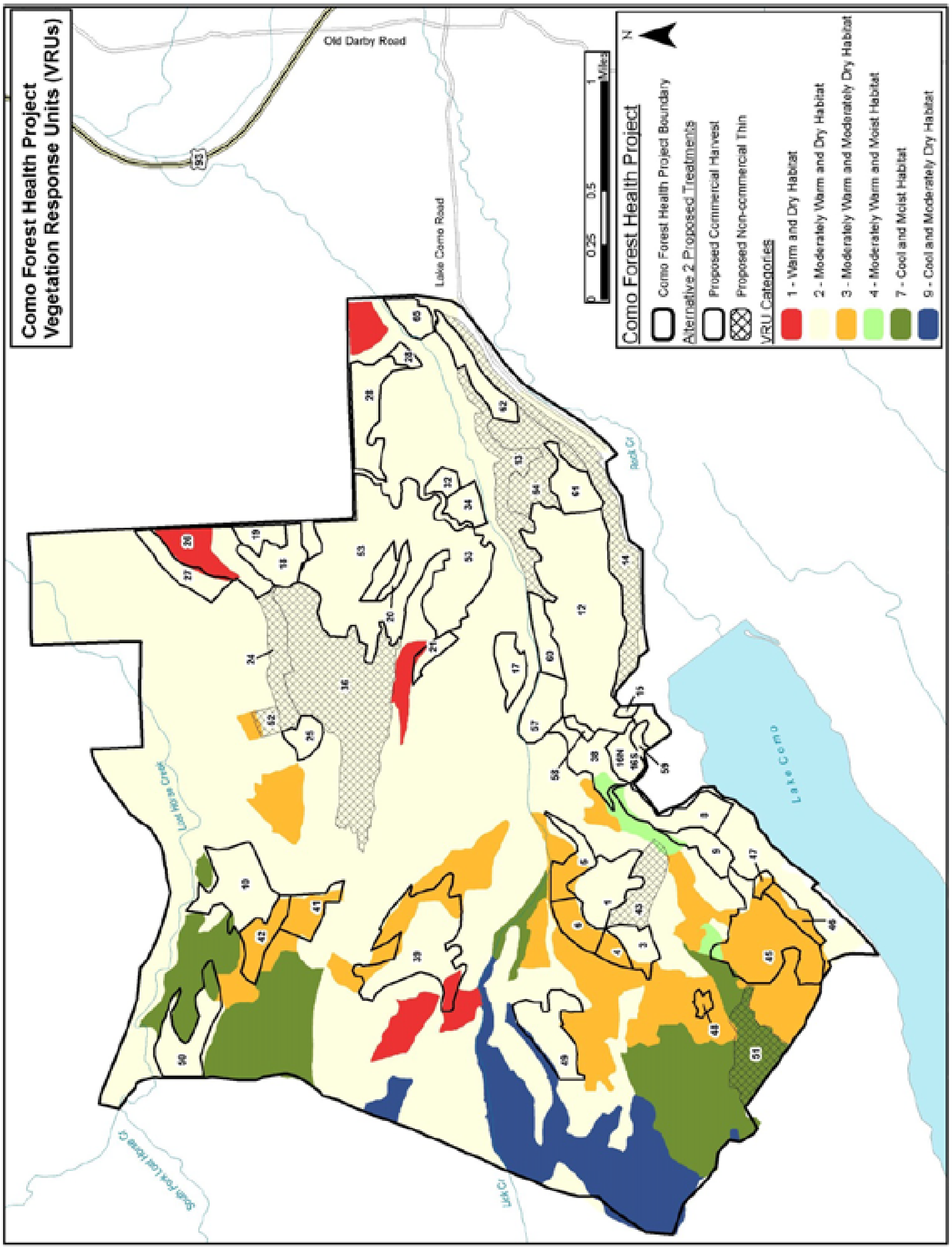

Figure 3.1- 1:Vegetative Response Units, Como Forest Health Project Area

Vegetation Response Unit 2

Vegetation Response Unit 2 is moderately warm and dry but is a transitional setting that includes warm, dry grasslands and moderately cool, dry upland sites. The dry, lower elevations are composed of mixed Douglas-fir and ponderosa pine in well-stocked to overstocked stands with increasing levels of Douglas-fir regeneration in the understory. Many units in the Como Forest Health project area are heavily overstocked with Douglas-fir, creating ladder fuels to the forest canopy. Also, dwarf mistletoe infests much of the Douglas-fir and adds to tree mortality in many units. Symptoms of declining vigor in many stands include narrow growth rings and scattered pockets of bark beetle mortality.

On the higher elevation, moist sites, ponderosa pine is less evident and the forest is a mix of Douglas-fir and lodgepole pine. Ponderosa pine is more prevalent on south and west aspects.

The primary fire group in VRU 2 is fire group 6 with a minor amount of fire group 4. Prior to fire suppression, fire was an important disturbance agent in this VRU, controlling forest density and species composition (USDA 1999). Low severity fires are representative of the warm dry sites with a fire return interval between 5 and 25 years. These low severity fires burned in a non-uniform, mosaic pattern, generally consuming litter and undergrowth. They created an open, ponderosa pine and Douglas-fir overstory with small canopy gaps, which created areas for ponderosa pine and Douglas-fir regeneration. Structural diversity remained high under these mosaic conditions. Ponderosa pine was favored because of its fire tolerance and ability to regenerate under these conditions (USDA 1999). On the cooler and moister sites, non-uniform mixed severity fires burned every 15 to 45 years (Fischer and Bradley 1987). Stand replacement fires occur in the moist microclimates or overstocked stands where fuels have increased during a fire-free interval of 150 to more than 400 years (Arno et al. 1995). Topography, habitat type, and tree species influence the fire interval variability. Lethal fires typically occur in overstocked stands or draws where high fuel loads accumulate during the long fire-free intervals. A dense understory creates a fuel ladder that carries fire into the crowns and throughout the stand. Although not uniform or expansive, these patchy fires resulted in overall stand replacement with even-aged stands. Stand replacement fires are outside the representative range of variation for this VRU but need to be considered given the fuel loads in the existing stands and their predisposition to high severity fires. Stand replacement fires are a larger threat on steep slopes because the ease with which the fire transitions from a ground fire to a crown fire. Because fire has been absent from this landscape, a larger proportion of the project area is predisposed to high severity fires. Fuel loads on representative habitat types of Fire Group 4 and 6 averaged 11-12 tons per acre (Fischer and Bradley 1987). Approximately 70 percent of the project area is in VRU 2.

Vegetation Response Unit 3 and 4

Vegetation Response Unit 3 and 4 are described as one unit because of their common features. VRU 3 is moderately warm and dry, and has characteristics of both the drier, warmer Douglas-fir habitat type and warmer, moister grand fir habitat type. VRU 4 is represented by the warmer, moister grand-fir habitat type. The habitat types classified within these VRUs typically occur on well-drained, lower to mid-slope benches and slopes. Within the project area, VRUs 3 and 4 are situated on north aspects and riparian areas. These VRUs contain highly variable assemblages of habitat types that reflect their wide distribution. Most of the habitat types are within the grand fir series and the cool moist

Douglas-fir series. Douglas-fir is a major tree component of seral stands in all the represented habitat types. However, across the gradient of habitat types, the mixture of tree species includes ponderosa pine, Douglas-fir, lodgepole pine, and grand fir in both seral and climax stands. The majority of habitat types within VRU 3 are from the grand fir series and ponderosa pine is a minor seral component in specific areas. Douglas-fir is a major seral component and grand fir is the intended climax tree species. The nature of varying fire regimes creates ideal conditions for the development of mosaics of seral and climax species forests. Habitat types on the drier and warmer borders of VRUs 3 and 4 are in the Douglas fir series, and on moister borders are in the subalpine series. Floristically, these VRUs are the most diverse because of vegetation composition and structure. Fire research indicates the three relatively dry grand fir habitat types found in the project area are grand fir/beargrass (*Abies grandis/Xerophyllum tenax*, ABGR/XETE), grand fir/twinflower (*Abies grandis/Linnaea borealis*, ABGR/LIBO), grand fir/twinflower-beargrass (*Abies grandis/Linnaea borealis-Xerophyllum tenax*, ABGR/LIBO-XETE). They undergo a post disturbance sequence that fits fire group 11 as described in Fischer and Bradley (1987). However, their fire ecology differs. These particular habitat types have a higher fire frequency, experience more underburning and fewer stand replacement fires, and the tolerant understory consists of Douglas-fir and grand fir. Arno and Peterson (1983) estimate a mean fire return interval of 30 years for grove-sized stands on the Bitterroot National Forest.

It is evident that fire severity is non-uniform, including both mixed severity and low severity fires. In terms of stand structures and species composition, a regime of mixed severity fires promotes highly diverse landscapes because of widely varying fire frequencies, severities, and spread patterns, especially in fire group 11 (Barrett 1996). The diversity of fire regimes is a result of temperature and moisture variation between the habitat types. Overall, these VRUs have been shaped by a combination of fire regimes, which were mainly low to moderate severity fires.

In Fire Group 11, average fuel loads are estimated to be 25 tons per acre, which exceeds that of any other fire group in Western Montana (Fischer and Bradley, 1987). Most of the down, woody fuel results from accumulated deadfall and natural thinning, but grand fir also produces a relatively heavy load of twigs and small branchwood. Because the habitats are moist, fire hazard is low to moderate despite the relatively high fuel loads under normal conditions (Fischer and Bradley 1987).

Grand fir on moderately moist (mesic) sites stays cooler and moister than on drier sites throughout the growing season. Fuels also stay moister on these sites and thus, reduce the potential for large or severe fires. Although mesic sites experience lightning strikes, few lightning strikes result in large wildfires. Many stands within the project area are old, with diameter distributions that indicate an uneven-age structure.

Seral species are poorly represented because fire free intervals on mesic sites are often longer than the average lifespans of seral tree species (Ferguson 1991). VRUs 3 and 4 represent about 11 percent of the project area.

<u>Vegetation Response Unit 7</u>

Vegetation Response Unit 7 is in the moist, lower elevation subalpine forest and is common on northwest to east facing slopes, riparian, and poorly drained subalpine sites in the Como Forest Health project area. This VRU occupies a broad subalpine zone that is bordered by subalpine fir and lodgepole pine on cooler and drier elevations of VRU 9. Douglas-fir, lodgepole pine, and Engelmann spruce often form the overstory with a dense understory of subalpine fir and some spruce. While grand fir is present, much of the VRU is at its upper elevation limit.

The general succession for fire groups 8 and 9 is quite similar. Both groups share many of the same seral and climax tree species, and have much the same fire response. However, the two are primarily distinguished by fire frequency and severity. Fire group 8 experiences more frequent, generally less severe fires than fire group 9. Vegetation in fire group 9 has less chance of burning than vegetation in fire group 8 because of the more mesic conditions. These sites are so cool and moist that times when effective broadcast burns can be achieved are limited. The moisture content of the duff must be low enough to allow the fire to expose bare mineral soil (Fischer and Bradley 1897). Often, such favorable moisture conditions occur only during late summer.

Most habitat types in VRU 7 are in Fire Group 9. Fire plays an important role in the development of species composition in this VRU. Fires typically are non-uniform and relatively infrequent, which causes mostly low severity or stand replacing fires with periodic mixed severity fires (Fischer and Bradley 1987). Fire return intervals are estimated at greater than 120 years for most sites (Fischer and Bradley 1987). Additional research demonstrates that non-uniform, infrequent stand replacement fires are the most common, occurring within a mosaic on low severity and mixed severity fires (USDA 1999). Arno (1980) estimates the fire interval at more than 100 years in the lodgepole pine/Douglas-fir cover type. Non-uniform, mixed severity fires are less common, but occur at a frequency of 38-120 years in lodgepole pine/Douglas-fir cover types (Losensky 1993). These types of fires create large canopy gaps and mosaic conditions that included patches of even-aged stands, with surviving groups and individual trees. The natural development of this VRU has not been affected by past fire suppression (Fischer and Bradley 1987). Management objectives of these areas are oriented toward non-consumptive use such as roadless areas and big game sanctuary.

Down, dead, woody fuel averages about 25 tons per acre but can be much higher (Fischer and Bradley 1987). This VRU comprises 8 percent of the project area. Minor amounts of this VRU are proposed for prescribed burning with no commercial harvest.

Vegetation Response Unit 9

Vegetation Response Unit 9 is cool and moderately dry with a short growing season and early summer frosts. Lodgepole pine is the seral dominant in most stands, with Douglas-fir occurring as scattered overstory relics. Englemann spruce and subalpine fir are minor stand components, particularly where stand replacement fires have been absent. Whitebark pine may occur as a minor seral species.

Within VRU 9, fire groups 7 and 8 are represented and each has a different fire regime. In the Como Forest Health project area, fire group 8 represents the habitat types in this VRU. The overstory of the dry, lower subalpine habitat type, subalpine fir/beargrass (*Abies lasiocarpa/Xerophyllun tenax*, ABLA/XETE) is composed of mixed species that include lodgepole pine. Arno (1985) reports that 40 to 67 percent of mature stands in subalpine fir/beargrass habitat types showed evidence of periodic underburns, particularly in upper elevations of the lodgepole pine cover type (Barrett 1982). Barrett (1982) found that fires originating at high elevations, in these habitat types and fire group, tend to be small and burn at low severity. Stand replacing fires generally average 100 years with some mixed severity burns occurring between 50-130 years (Fischer and Bradley 1987).

Where timber production is not a management objective, opportunities may exist for the use of prescribed fires to accomplish fire management objectives to create vegetative mosaics reducing the probability of widespread wildfire (Fischer and Bradley 1987).

Down, dead, woody fuel averages about 20 tons per acre but can be as high as 80 tons per acre (Fischer and Bradley 1987). This VRU comprises 5 percent of the project area. Prescribed fire is proposed but not commercial harvest.

Forest Composition

To compare historical and current forest compositions, an understanding of the natural vegetation and the influences of natural processes is essential to determine how natural diversity changed, to what degree, and how the existing vegetation coincides with ecological and climatic processes. The term natural in this analysis represents the vegetation present at the time that large numbers of European-Americans settled the area. The vegetation structure was at least somewhat stable as documented with fire history investigations and bog analysis (Losensky 1995).

Historical

It is evident from early photographs, accounts of early forest conditions (Lieberg 1899), and fire history studies (Arno et al. 1997, Gruell et al. 1982) that lower elevation forests in the Como Forest Health project area were uneven-aged and largely self-perpetuating stands of large ponderosa pine before logging and the advent of fire suppression in the early 1900s. These stands had fire return intervals of 3 to 30 years (Arno 1976) (Figure 3.1- 2 and *Figure 3.1- 3*). Table 3.1- 2 displays percentages of forest cover type by structural stage. Within the ponderosa pine cover type, over 78% was in mature to over-mature structural stages.

Field observations and photos by Leiberg (1899) and historical timber data from the Anaconda Copper Mining Company (ACMC) indicate large ponderosa pines had grassy understories with frequent fire. The pre-1900 fire regime brought about the development of uneven-aged stands of ponderosa pine. Douglas-fir saplings are more readily killed by surface fires, whereas some ponderosa pines often survive. Because of the higher ponderosa pine sapling survival rate, there was continual selection against Douglas-fir. According to Arno (1995) these overstory pine often could live up to 600 years. When they died, openings occurred and they were replaced by groups of regeneration. Fire chronologies for photo points within Lick Creek determined that 42 fires between 1600 and 1900 had occurred yielding a mean fire interval of 7 years (USDA 1999). Additionally, aerial photos from 1937 indicate the area surrounding and within the project area have old fire scars in the upper elevations of the project area (Figure 3.1- 4).

Logging, similar to fire, has affected forest composition and structure. Logging in the Bitterroot Valley began in the mid-1800s. The Bitterroot lumber industry expanded from subsistence logging and milling for local use to providing mass quantities of timber for hard rock mines, railroads, and growing cities.

Aerial photographs from 1937 show most of the area surrounding and within the Como Forest Health project area had some type of harvest (Figure 3.1- 5, Figure 3.1- 6). The amount and extent of harvesting was not the same throughout the area. Portions of the

B. YELLOW-PINE FOREST IN THE BITTERROOT VALLEY NEAR KAMAS CREEK; CAPACITY OF THE TRACT PICTURED, ABOUT 15,000 FEET B. M. PER ACRE.

Figure 3.1- 2: Leiberg Photograph (1899) of a Ponderosa Pine Stand near Lost Horse Creek before Fire Suppression. Notice large diameter ponderosa pine, clumpy distribution and grassy understory with low fuel loads. Fire frequency was 3 to 30 years.

U. S. GEOLOGICAL SURVEY NINETEENTH ANNUAL REPORT PART V PL. LXX

A. YELLOW-PINE FOREST NEAR THE OUTLET OF OVERWHICH CREEK, ABOUT 700 ACRES IN THE TRACT, AVERAGING NEARLY 8,000 FEET B. M. PER ACRE.

Figure 3.1- 3: Leiberg Photograph(1899) of Ponderosa Pine Stand. Note the wide tree spacing, variety of ponderosa pine diameter classes, and grassy understory with low fuel loads.

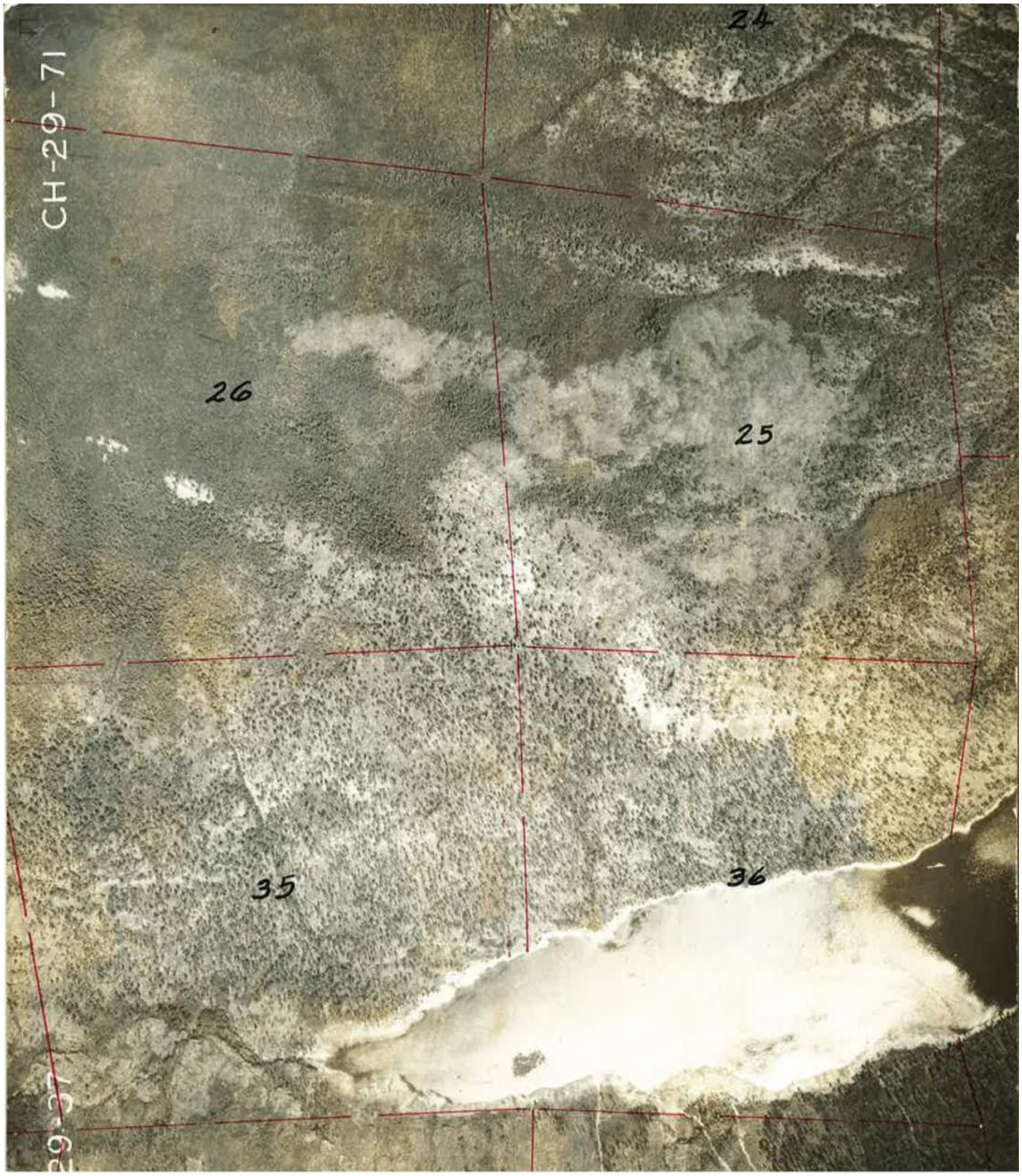

Figure 3.1- 4: 1937 Aerial Photograph, Section 25 is Proposed Unit E and Unit 51. Note lack of trees around the number 25, which indicates a recent severe fire.

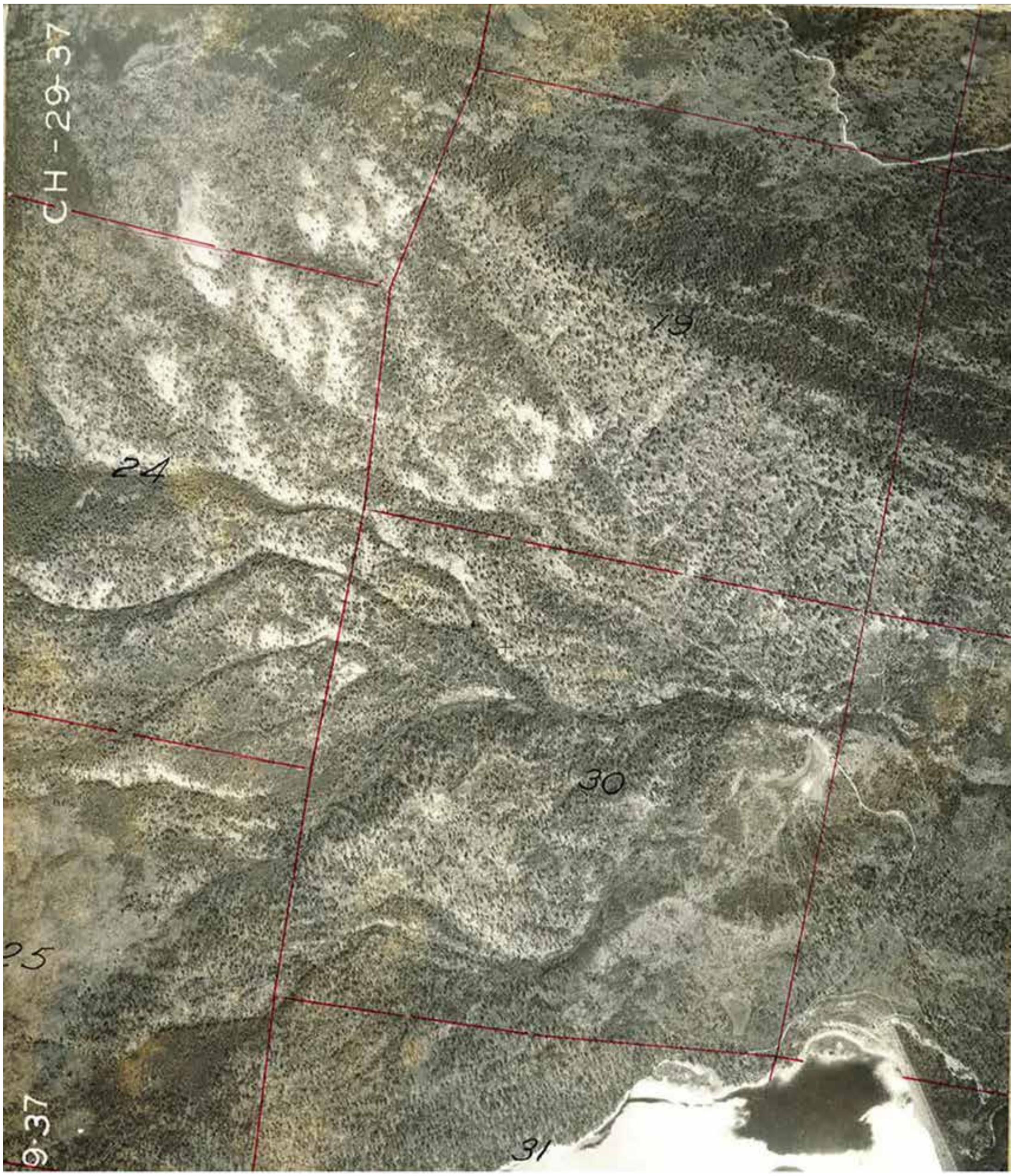

Figure 3.1- 5: 1937 Aerial Photograph of the Como Forest Health Project Area. Note the extensive and intensive areas of timber harvest in sections 19, 24, and 30 but less to no harvest on north-facing slopes of stream corridors. Lower left corner in section 25 is an large opening created by a severe fire.

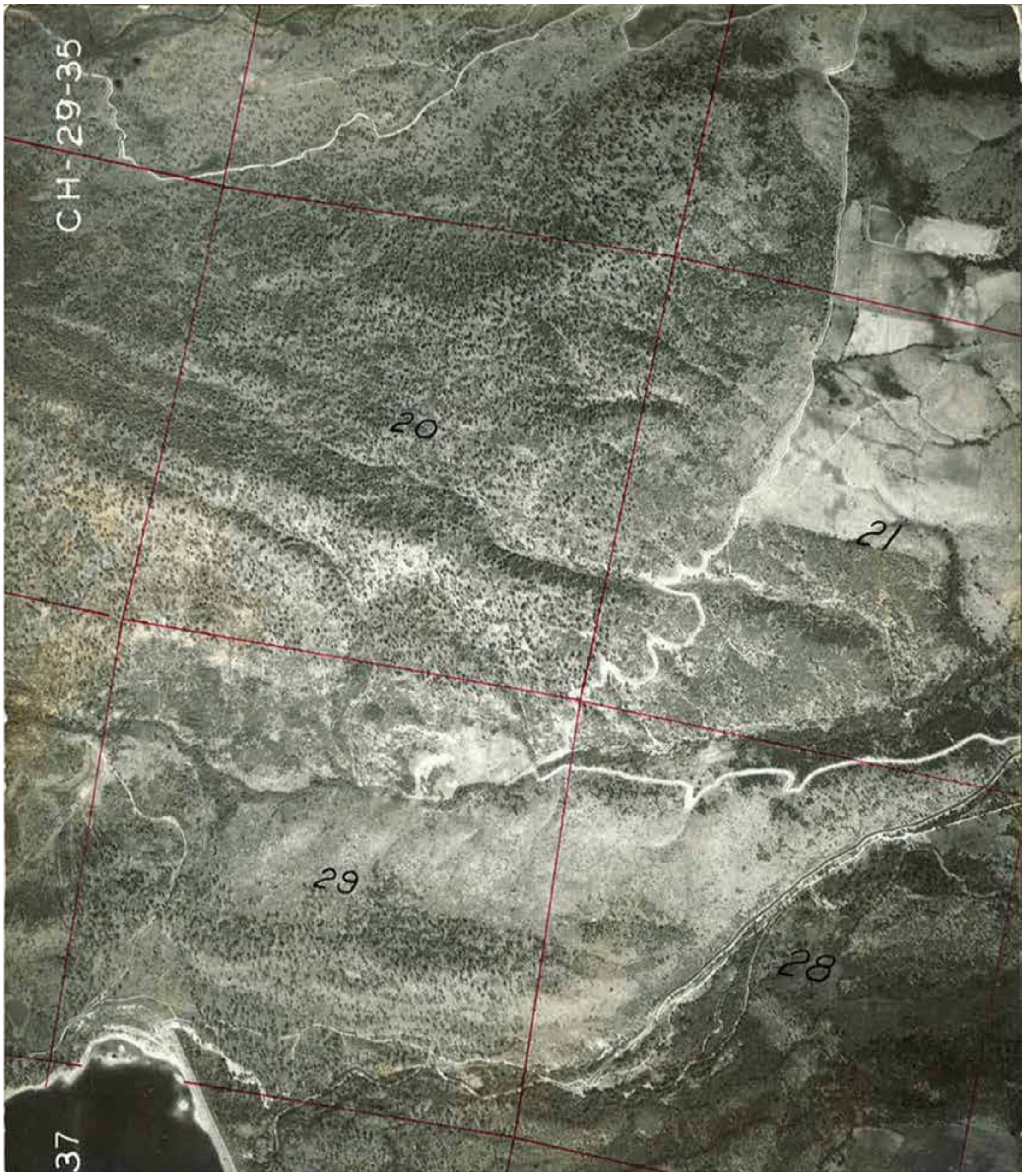

Figure 3.1- 6: 1937 Aerial Photograph of the Como Forest Health Project Area. Note there is less or no harvest on the north-facing slopes of the stream corridors

project area were extensively logged with the removal of most of the forest, as well as areas that were selectively harvested as indicated in photos taken by Lubken (Figure 3.1-8, 3.1-9) and the 1937 aerial photographs

Old-Growth

The historical composition was mature to over-mature structural stages (Table 3.1- 2). In western Montana stands of ponderosa pine, "the term old growth often refers to late seral, mature subclimax forests 200 to 500 years old, maintained originally in an open-canopied savanna state by frequent ... low-intensity ground fires" (Habeck 1988). As described by Lieberg et al., old-growth stands occurring on sites classified within the

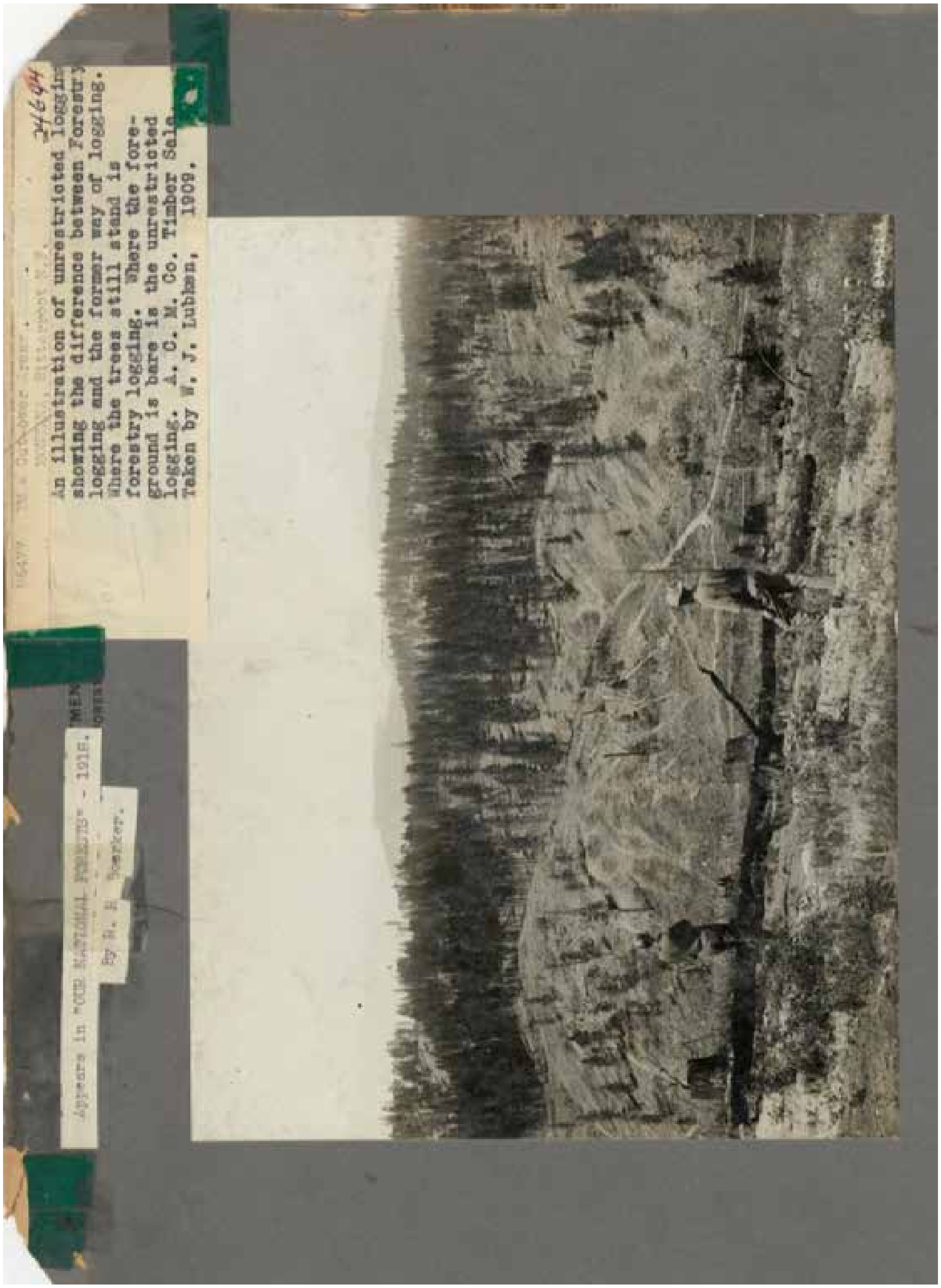

Figure 3.1- 7: 1909 Photograph of Harvest Unit in Lick Creek Showing the Difference between Unrestricted Logging and Selective Harvest ("forestry logging"). The area with trees is the current Lick Creek research unit 22.

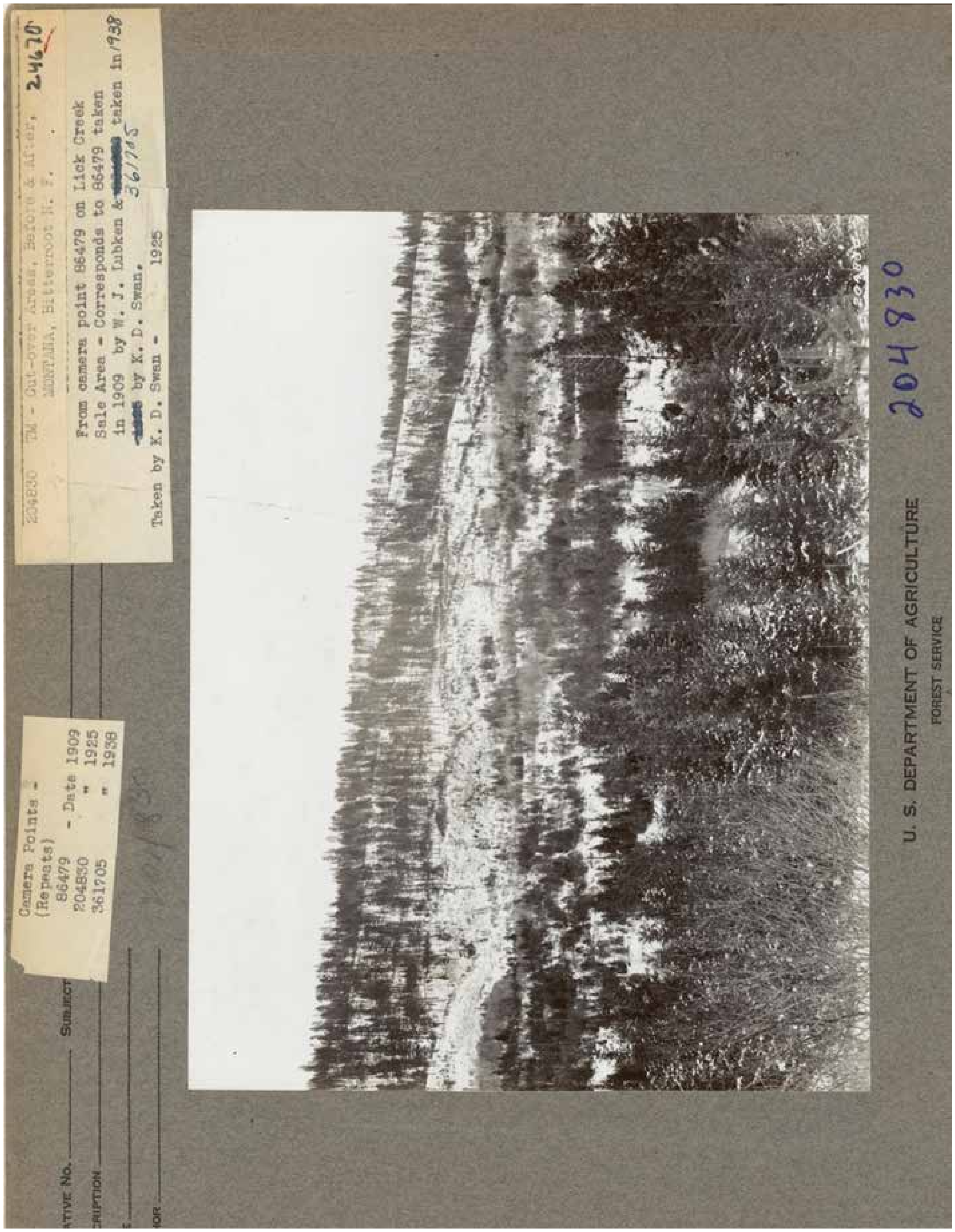

Figure 3.1- 8: 1938 Photo Point from Same Location as 1909 in Cut Over Area in Lick Creek from Previous Photo (Figure 3.1-5). Looking north into the area of the current Unit 22 in Alternatives 3 and 4. Note the development of shrubs and pine regeneration.

Figure 3.1- 9: 1908 Photograph of Selective Harvest in Lick Creek Sale. The area is the same location as Unit 12 in all the Como Forest Health project alternatives.

frequent fire regime were historically dominated by ponderosa pine. Many of these historical old-growth stands were characterized by clumpy to random spatial arrangement (Cooper 1961, Morgan et al. 2002). Reviewing historic data, Greene et al. (2005) determined that the bulk of the pre-settlement upland old-growth in the Northern Rockies was in the lower elevation, ground-fire maintained ponderosa pine/western larch/Douglas-fir habitat types as reflected in Table 3.1- 2.

Mixed conifer forests also develop as old growth and are not in frequent fire landscapes. Mixed conifer old growth forests occur on moderately cool to moderately dry, warm, moist sites that are predominately Douglas-fir and grand fir, which are modestly represented in the project area (Table 3.1- 2). These forests border riparian areas and sometimes were not easy to harvest due to slope. These areas are well depicted on aerial photographs from 1937 (Figure 3.1- 5 and Figure 3.1- 6) because most of the stand structure shows as denser than surrounding areas. Due to the length of fire frequency and mixed severity in these stands, they were multistoried with shade tolerant species regenerating in the understory. As a result of moderately frequent fires and variable fire severities, these stands often formed a complex an intricate mosaic on the landscape. Creating mosaics across the landscape causes different successional stages creating diversity in the forest. The proportion of successional stages would have varied over time.

Current

Losensky (1995) provides a reference point for evaluating changes over time that result from management practices or the control of natural processes, such as fire, in his report, "Historical Vegetation Types for the Interior Columbia River Basin."

Table 3.1- 2 displays the historic and existing cover types by structure class. This table provides a reference for inferring appropriate cover types and structure classes in the Como Forest Health project area. The historic data set includes the entire Ecological Subsection M332B of almost 5 million acres. Current cover types, stratified by age structure class, were derived from the FSVeg database. The existing condition percentages were calculated on National Forest in the Como Forest Health project area (approximately 5,711 acres). Private land data was not included in the calculations. The area of the Como Forest Health Project data set is less than 1 % of the total area of Subsection M332B. While a one-to-one comparison cannot be made due to differing data set scales, accuracy of the historic data set, and accuracy and limitations of the FS-Veg data set, the general trends reflected in the table support trends identified through field reconnaissance of the project area by the silviculturist and foresters.

Table 3.1- 2: Historic and Existing Forest Structure by Cover Type in the Como Forest Health Project Area.

Cover Type (Losensky)	Nonstocked		Seedling/Sapling[1]		Poles[2]		Mature[3]		Over-Mature[4]	
	Hist. (%)	FS Veg (%)	Hist. (%)	FS Veg (%)	Hist. (%)	FS Veg (%)	Hist. (%)	FSVeg (%)	Hist. (%)	FSVeg (%)
ponderosa pine	4	0	10	7	8	11	11	65	67	17
Douglas-fir	4	0	18	0	31	16	23	74	24	8
lodgepole pine	9	0	34	.6	43	0	11	99	3	0
SAF[5]/Grand fir	0	0	<1	0	20	0	24	83	57	19

[1]Seedling'Sapling structure is 1-40 years old and up to 4.9 inches diameter-breast-height (DBH)
[2]Pole structure is 41-100 years old
[3]Mature structure in 101-150 years old
[4]Over-mature structure is 151 years and older and over 15 inches DBH
[5]SAF = subalpine fir (*Abies lasiocarpa*)

The decreasing trend in the over-mature tree component, as defined by size class, is readily apparent on the landscape. Most of the old, large diameter ponderosa pine and Douglas-fir trees were harvested over a century ago into the late 1950s. Within the original Lick Creek Sale, 35% of the ponderosa pine was retained in various size classes and practically no Douglas-fir over 10" diameter breast height (DBH) was retained. The mature size class in ponderosa pine and Douglas-fir currently exceeds historic percentages because trees retained in the mid-1800s up to present day are currently in the mature and over-mature size classes (Figure 3.1- 5).

The increase in mature size class and lack of seedling/sapling size class in lodgepole pine is attributable in part to fire exclusion. By the late 1930s, fire suppression had become effective in reducing the annual extent of fires, even in large wilderness areas in the northern Rocky Mountains (Barrett et al. 1991; Brown et al. 1994). A study of fire regimes in Glacier National Park concludes that fire suppression was very effective in areas that had a mixed severity fire regime, but much less effective in areas of stand replacement fire regimes (Barrett et al. 1991). On the landscape, the effects of fire exclusion tend to include greater uniformity in stand ages and in stand composition and structure, especially in fire groups 8 and 9.

Table 3.1- 2 reflects overstory cover type but not necessarily the understory. Though overstory Douglas-fir was mostly removed in the original logging, Douglas-fir regeneration increased in the absence of surface fires and because natural regeneration was not managed in the newly open stands. Sometimes the regeneration was thinned by hand, but this was usually very expensive and contributed to hazardous fuel loads.

Figure 3.1- 10: 1909 Photograph of the Lick Creek Timber Sale Showing the Density and Diameter of Residual Forest after Harvest. This photograph is in the same location as Unit 22 in the Como Forest Health Alternatives 3 and 4.

By the mid-1900s, undesirable effects associated with fire exclusion were becoming apparent in ponderosa pine ecosystems, as documented in "Eighty-Eight Years of Change in a Managed Ponderosa Pine Forest" (1999). Fire exclusion prevented the periodic removal of understory vegetation, allowing it to mature and increasing the stand density and competition for water and growing space. The existing stands are a product of succession in the absence of disturbance. Densities and species composition differ from historical conditions, as does the extent and continuity of various forest types across the landscape. The result has been a gradual trend toward the potential natural vegetation (the habitat type that would exist if no disturbance ever occurred). Higher densities of shade tolerant species are more prevalent, especially in the understory. Basal area and numbers of trees per acre increase dramatically (Arno et al. 1997). This results in increased physiological stress and the opportunity for extensive mortality caused by epidemics of insects and diseases (Fellin 1980, Monning and Byler 1992, Biondi 1996).

Currently, many of the stands are vulnerable to increasing insect infestations and disease rates because of high stocking densities. The current outbreak of mountain pine beetle in parts of the project area is directly caused by the uniformity and density of mature ponderosa pine. The lack of structural diversity in the project area affects all cover types. Field observations indicate high departures from reference conditions in the smaller size classes. The seedling/sapling and pole size class are less common and almost nonexistent. There is a definite loss of multi-aged stands of seral tree species.

Ponderosa pine is the dominant cover type in the project area. It accounts for 59 percent of the forested land (Table 3.1- 3. Most of the cover type is mature to over-mature. Douglas-fir accounts for 35 percent of the project area. Mature ponderosa pine and Douglas-fir cover types are the focus of proposed timber harvest, and prescribed fire without timber harvest targets the lodgepole pine cover type in the project area.

Table 3.1- 3: Existing Cover Type of Proposed Timber Harvest and Prescribed Fire Treatments by Alternative in the Como Forest Health Project Area.

Forest Cover Type		Area and Percent of Cover Type Proposed for Treatment			
(FS Veg)	Project Area Total (Acre)	Alt. 1 (Acre)	Alt 2 (Acre)	Alt 3 (Acre)	Alt 4 (Acre)
ponderosa pine	3346 (59%)	0	1962 (58%)	1987 (59%)	1570 (47%)
Douglas-fir	1994 (35%)	0	1125 (56%)	957 (48%)	546 (27%)
lodgepole pine	227 (4%)	0	189 (83%)	189 (83%)	0
sub-alpine fir	55 (1%)	0	31 (56%)	30 (54%)	2 (4%)
Aspen	21 (0.4%)	0	0	0	39[1] (NA)

[1]Some areas of aspen treatment are inclusions within other forest cover types so the area of aspen treatment exceeds the area of the aspen cover type.

Old-growth

Old growth forests are ecosystems distinguished by old trees and related structural attributes. They encompass the later stages of stand development that typically differ from earlier stages in characteristics such as tree age, tree size, number of large trees per acre, and basal area. In addition, attributes such as decadence, dead trees, the number of canopy layers and canopy gaps are important but more difficult to describe because of high variability (Greene et al. 2006).

The percentages of current old growth have declined compared to historical percentages (Table 3.1- 2). One reason for the decline is early 1900s timber harvest selected for large ponderosa pine and reduced the amount of old-growth habitat at lower elevations. Another reason is large, stand replacing fire has been absent from the project area since

1900. However, not all old-growth was removed. The remaining stands of old-growth in the project area are predominately ponderosa pine or mixed conifer with varying amounts of Douglas-fir, grand fir, and ponderosa pine. As listed in Greene et al. (2006), these stands are Old-Growth Type Code 1 and Old-Growth Type Code 5 (Refer to the old growth section (3.3.1) in the wildlife section). Many stands of mature trees could become replacement old growth (Table 3.1- 2) with enough time to achieve the appropriate age class. Stand age not tree size is the criteria which most often keeps these stands from meeting the definition of old growth. However, these stands may not achieve old growth status or be sustainable without intermediate treatments.

Losenksy's report and the study by Greene et al. are not a one to one comparison. Losensky defines all trees older than 151 years and above 15 inches dbh as over-mature. Greene et al. defines old growth by the number of large trees and over a specific age by habitat group. Old growth exams in the project area indicate many trees fit the diameter requirement but are delinquent in meeting the age requirement. To retain and recruit old growth in the over-mature tree structure, silvicultural prescriptions would retain larger trees while encouraging a staggered age class for recruitment and retention, but this may not be sustainable without intermediate treatments.

Old-growth ponderosa pine stands in the project area are characterized by an increase of Douglas-fir competition, high stand density, and marked changes to forest structure. They are at risk from severe wildfire, insect infestations, and shifts in species composition. Given the extreme stresses these forests have sustained, it is remarkable that any ponderosa pine old-growth has persisted. The ponderosa pine old-growth do not resemble those of pre-settlement conditions, however, if trends of severe wildfire continue, little of this modified old growth will remain in the coming decades. The threat of losing old-growth to stand replacing fires and to insects and disease is supported by recent history on the Bitterroot National Forest. In the fires of 2000, approximately 33,000 acres of old growth was lost to stand replacing fires.

Mixed conifer old growth, represented by Douglas-fir and grand fir, also occurs in the project area and shows a decline in the over-mature structural class (Table 3.1-2). However, the amount of mature structural stage has increased as compared to historic conditions and could replace the over-mature structural stage. The existing amount of mixed conifer old-growth is approximately within reference condition as it relates to density, structure, and species composition. The mixed conifer old-growth types occur on moderately cool to moderately dry warm moist sites on north slopes and along riparian areas. They are multistoried, have high amounts of downed woody material, and optimal numbers of snags.

Disturbance

Ecological processes and disturbances directly affect the diversity of plant and animal communities within an area over space and time. The better we understand this interrelationship, the better we will be able to plan our actions to maintain healthy, properly functioning ecosystems. Ecological processes and disturbances include nutrient and biomass cycling, forest succession, weather events, insects, pathogens, fire, and human influences (i.e. timber harvest). The primary disturbances or factors of change, influencing forests in the project area include fire, insects, pathogens, and timber harvest.

Fire

Fire was historically the dominant agent of change and filled a very important role in Rocky Mountain ecosystems. Fires are natural modifiers of the vegetation, sometimes killing all trees and above-ground parts of vegetation (high severity, stand replacement fire), sometimes killing only smaller trees or no trees at all and only burning understory grasses and shrubs (low severity). In the northern Rockies, low severity fire regimes are primarily confined to forests where ponderosa pine was historically dominant. Low severity fires would burn non-uniformly consuming the litter and undergrowth, leaving an open overstory of larch, ponderosa pine, and Douglas-fir largely intact and creating small canopy gaps. Mixed severity fire regimes are found across a broad range of forest types, including Douglas-fir and western larch, lodgepole pine, whitebark pine, as well as some relatively moist ponderosa pine types (Arno et al. 2000). Fire releases nutrients to soils and streams. Fires affect the amount of dead, woody material and snags on a site. The historical frequency and intensity of fires were highly variable across the Bitterroot landscape, depending upon such factors as elevation, aspect, vegetation and fuel conditions, terrain, and weather. Most fires were lightning-caused. However, fires set by indigenous people living in this area before white settlement played a significant role particularly in the lower elevation forest types (Arno 1976, Barrett 1981). In some of the drier ponderosa pine forest types, low intensity fires burned through the stand every 6 to 7 years (Arno 1976). Generally, as you move into the moister and cooler forest types, intervals between fires increase and high severity fires are more common.

Perry et al. (2011) state that a "large amount of edge and clumpiness in forest structure, composition, and seral status within and among patches provides a rich intermingling of habitats for early, mid-, and late-successional specialists as well as a variety of individual species." The authors also state that forests evolving with mixed-severity fire regimes "exhibit temporal as well as spatial variability." These suggestions all advocate that heterogeneity should be introduced into management designs to address a variety of integrated objectives.

Several studies found a marked decrease in the number of fires occurring in the Bitterroot Mountains since around 1920 and a corresponding increase in fire intensity (Arno 1976, McCune 1983, Brown et al. 1994). A detailed study of the entire inland portion of the northwestern United States also concludes that areas historically in low or mixed severity fire regimes have shifted into stand replacement regimes (Arno et al. 2000).

Possible reasons for this change are increased fuel loads, weather, and successful fire suppression, especially on lower intensity fires. Suppression of fire in these ecosystems during the 20th century may be the factor affecting the largest proportion of vegetation across the Bitterroot landscape.

Insects and Pathogens

Susceptibility of forest stands to insects and diseases depends on a variety of factors such as species composition, size class, age, stocking, and environmental stress such as drought. Most insects and diseases are endemic and vital to ecosystem function. Indigenous pathogens certainly are natural and necessary parts of the ecosystem. In most forest ecosystems, they are also the main nutrient recyclers. Our perception and acceptance of this role has changed in recent years with acknowledgement that endemic levels of insect and disease are a desirable level to manage for. Stands outside historical

Figure 3.1- 11: Witches brooms in unit 57 (FHP photo)

conditions are at a higher risk for insect infestations and disease infections that achieve epidemic levels.

In this section, those insects and pathogens that are of most concern and have had the most obvious influence on the forest within the Como Forest Health project area include: dwarf mistletoe and bark beetles.

Dwarf mistletoe

Douglas-fir dwarf mistletoe (DFDM) is a parasitic flowering plant that reduces diameter and height growth, alters tree form, reduces seed production, and increases susceptibility to other damaging agents. It can directly kill treetops and cause whole tree mortality in small trees with stem infections and all sizes of trees with severe infections (Hadfield et al. 2000). DFDM robs infected trees of water and nutrients and stimulates production of large, often globose, witches'-brooms (proliferation of branches) with long, thin pendulous branches Figure 3.1- 11). Light infections can reduce basal area growth by about 10 to 15%, whereas moderate to severe infections can reduce basal area growth by about 40 to 70% (Pierce 1960). However, DFDM and its witches'-brooms provide wildlife habitat such as food, hiding, thermal cover, and nesting for birds and mammals.

DFDM is mostly spread by explosively discharged seeds. Although seeds can travel up to 40 feet, they usually land within 10 to 15 feet if unobstructed. Long distance spread is less common and occurs when the sticky seeds attach to birds or mammals who later rub them off on susceptible trees.

DFDM spread is affected by tree species composition, spacing, stand structure, infection position, tree size, and topography (Hadfield et al. 2000). Although spruce, grand fir and subalpine fir are rarely infected, Douglas-fir is the only significantly impacted host for this pathogen in Montana. DFDM spreads less than 2 feet per year on average in a single story stand, but can spread much more quickly in multistory stands where dwarf mistletoe seeds rain down from overstory infections onto understory trees. Spread rates are usually slower in dense stands because trees act as barriers to seed flight and shading reduces dwarf mistletoe seed production. Trees less than 4 feet tall have low infection rates even though all ages and sizes of Douglas-fir are susceptible. DFDM tends to spread more rapidly from ridges than narrow valley bottoms.

The "6-class" dwarf mistletoe rating (DMR) system is commonly used to categorize trees by their infection severity (Hawksworth 1977). Trees are rated by visually dividing live crowns into thirds, rating the bottom, middle, and top thirds, and summing the thirds.

Since DFDM plants are very difficult to see due to their diminutive size, infected branches are identified by the presence of witches'-brooms. For each third; no DFDM infections receive a rating of zero, half or less than half the branches infected receives a rating of one, and more than half the branches infected receives a rating of two. Overall tree ratings can range from zero (no infections visible) to six (most severe). Stand DMR is determined by averaging all tree ratings, including trees without infections. Although highly variable, individual tree DMR will increase by about one class per decade on average. DFDM generally intensifies more rapidly on small diameter trees than large diameter trees (Geils and Mathiasen 1990). Infections often begin in lower crowns and move up trees 4 to 6 inches on average per year, but rate of upward movement can be highly variable.

Abundance of DFDM has increased over the last 100 years and more due in part to fire suppression (Alexander and Hawksworth 1975). Fires historically kept DFDM in check by replacing severely infected stands and removing small, infected trees and low hanging witches' brooms in less intense fires. Since dwarf mistletoes require living hosts, they are eliminated by stand replacing fires. Additionally, selective harvests, which often left poor quality, infected Douglas-fir, contributed to increased abundance of the disease. Both fire suppression and poor harvest practices have been important in development of heavily affected stands in the Lick Creek and Lost Horse Creek drainages.

Thinning in areas of non-infected or lightly infected (DMR 0 – 2) trees may improve growth of current overstory trees (Knutson and Tinnin 1986). However, where infections are well distributed as they are in most of the Lick Creek and Lost Horse Creek stands that were visited by Forest Health Protection (FHP) staff, intensification of DFDM can be expected to accelerate with any form of thinning treatment. Dwarf mistletoe suppression in Douglas-fir is not effective under uneven-aged management (Merrill et al. 1988). If timber volume is a priority for these stands, the best practices to address DFDM over the long-term include stand replacement and emphasis of non-host species such as ponderosa pine. Shelterwood and seed tree harvests can be done with retention of uninfected or lightly infected (DMR <3) seed trees; however, infected trees should be removed or girdled as soon as the understory is established. Generally, overstory trees should be removed before regeneration is 3 feet tall or 10 years old since little infection is expected before then. Leaving an infected overstory will perpetuate volume losses currently caused by DFDM in these stands.

Forest Health Protection staff (MFO-TR-13-02) advise to eliminate losses from DFDM, Douglas-fir stands would need to be removed from infected stands. If volume production is the primary management objective, non-host species should be planted after regeneration harvest. If Douglas-fir must be maintained as the primary species, losses will continue from DFDM. Since DFDM is well distributed throughout much of the area we visited, one can expect it to move in to Douglas-fir regenerated stands along borders with uncut, infested stands. Therefore, larger areas with smaller perimeter to area ratios will provide for greater reductions in dwarf mistletoe impacts. Long, narrow strip harvests should be avoided. If maintaining Douglas-fir as a primary timber species, dwarf mistletoe suppression in generally infested areas is usually most effective with circular or square regeneration harvests of at least 20 acres. About 5 to 15% volume loss from DFDM can be expected over a 120-year rotation within these opened areas (Dooling and Brown 1976). Twenty to 25% volume loss can be expected within 5-acre openings and 30% to 40% loss within 2-acre group selections over the same period of time (Hoffman 2004). Since almost 80% of the opening would be within 40 feet (mistletoe seed range) for 0.25-acre openings, at least 50% volume loss seems reasonable over a 120-year rotation. These estimates are based on lodgepole pine and western larch models, but loss in Douglas-fir can be expected to be similar (Pierce 1960). The estimates presume the entire border around these stands contain infested overstory. Roads, natural openings, non-host trees, and treeless ridge tops can be used as barriers to DFDM spread when identifying harvest unit boundaries.

Also, there are possibilities of creating a Douglas-fir free zone around retained overstory Douglas-fir. This practice could be used to retain wildlife trees while reducing the continuing impact of DFDM. A Douglas-fir regeneration-free zone of at least 40 feet would be needed around these trees, with this zone expanded below infected trees on slopes. The effectiveness of this practice would rely on continual maintenance by removing Douglas-fir ingrowth since this is the primary regenerating species in the stands.

DFDM is expected to continue causing significant growth losses until large tree-free openings (greater than 20 acres) are created by either harvest activities or fire. Thinning would increase the rate of dwarf mistletoe intensification in most areas the pathologists visited. Where little to no DFDM is detectable, thinning may increase growth of current crop trees, but increased infections in future Douglas-fir regeneration should be expected until larger openings occur. If treatments are undertaken and Douglas-fir must be left for wildlife trees, leave trees should be girdled before regeneration is three feet tall or ten years old, whichever comes first, to minimize future impacts from DFDM.

Risk of Bark Beetle Predation

Populations of western pine beetle (*Dendroctonus brevicomis* LeConte*)* and Douglas-fir beetle *(Dendroctonus pseudotsugae Hopkins),* are currently low in the project area and mountain pine beetle *(Dendroctonus ponderosae* Hopkins*)* is increasing. Current forest conditions are suitable for mountain pine beetle populations of to increase and increase tree mortality. Current conditions within the project area such as host species, size, and stand density, create moderate to high conditions beyond the historic range.

Mountain Pine Beetle (*Dendroctonus ponderosae* Hopkins)

Mountain pine beetle is the most aggressive, persistent, and destructive bark beetle in the United States. Mountain pine beetle attacks all western species of pine, native and introduced. The larvae feed on the inner bark and often kill the tree. Populations can build up to very high levels (epidemic) and cause large-scale mortality when forest conditions are at favorable, "high risk" conditions (Randall and Bush 2010). Ponderosa pine is susceptible to a number of tree killing bark beetles including mountain pine beetle, the western pine beetle, and the pine engraver beetle (*Ips pini*). Mountain pine beetle and western pine beetle are most likely to affect mature stands of ponderosa pine. Bark beetles respond to stressed ponderosa pine. Stands most susceptible to bark beetle attacks have a high composition of susceptible host, or dense stands of large diameter ponderosa pine. There are some subtle differences in ponderosa pine stands susceptible to mountain pine beetle and those susceptible to western pine beetle, but for the purpose of analysis, we have combined these two beetles in the hazard rating criteria. Hazard ratings as defined by Randall and Bush (2010) are in Table 3.1- 4.

Table 3.1- 4: Hazard Criteria for Mountain Pine Beetle/Western Pine Beetle in Ponderosa Pine (Randall and Bush 2010).

CRITERIA	STAND ATTRIBUTE	LOW (.5)	MODERATE (2)	HIGH(3)
A	QMD of ponderosa pines >5" DBH (inches)	< 6" DBH	6" < QMD < 10"	> 10" DBH
B	Basal area (BA) of all species (ft^2/acre)	BA < 80	80 < BA < 120	> 120
C	% of total BA that is ponderosa pine >5" DBH	< 40% BA	40% < % BA< 65%	>65% BA

Hazard is defined by two factors--the quality and the quantity of susceptible ponderosa pine. The quality of the ponderosa pine component of a stand as a mountain pine beetle or western pine beetle food source is best characterized by stand density and phloem thickness. Since ponderosa pine phloem thickness is not generally measured in most inventories, DBH, and age are stand characteristics that are used as surrogates. The quantity of the food source refers to the species composition and density of the forest. A pure, well-stocked ponderosa pine stand will be more likely to support a large mountain pine beetle population than a mixed species and/or poorly stocked stand.

Mountain pine beetle appears to be at similar levels or increasing at Como Lake in 2013. In 2013, both ground surveys and Aerial Detection Surveys show that mountain pine beetle is still very active near Como Lake and killing approximately 4-5 TPA and small groups of 5 to 40 trees in both LPP and ponderosa pine. Also, pockets of trees killed by mountain pine beetle in 2012 can still be found in some stands in both drainages. Currently, mountain pine beetle is primarily attacking small and mid-size trees. In most of the small ponderosa pine trees examined (>5 inches), we did not find any viable brood. We did find 3rd and 4th instar larvae in the mid-size trees (11 to 18 inch DBH) we examined during our site visit. Very little to no brood is produced when smaller trees are attacked thus they create a population sink and may indicate population decline.

Outbreaks of mountain pine beetle in ponderosa pine have historically not been as widespread as in lodgepole pine, but can be devastating, killing ponderosa pines as young as 30-40 years of age. Most mountain pine beetle outbreaks occur in even-aged, high-density stands. More recently on the Helena NF, mountain pine beetle-caused mortality in some areas was higher in ponderosa than lodgepole pine. For ponderosa pine, stands with basal areas exceeding 150 square feet per acre and average diameters greater than 8" are considered highly favorable for mountain pine beetle outbreaks (Schmid et al. 2007). Schmid et al. (2007) found that unlike in lodgepole pine, mountain pine beetle in ponderosa pine attack a range of diameters. Therefore, silvicultural treatments with endemic or building populations can be designed to leave some of the larger trees in ponderosa pine stands. Schmid et al. (2007) and Olsen et al. (1996) found that mountain pine beetle attacked trees occurred in clusters and the hazard rating for stands with clumpy distributions is increased. In other words, even if a stand has a basal area of 80 square feet per acre but has denser clumps distributed within, significant mountain pine beetle-caused mortality may occur in those clumps and lead to additional mortality within the stand. Olsen et al. (1996) suggested that the competition between trees in clusters placed stress on individual trees predisposing them to attack. A more even spacing within a stand leads to less inter-tree competition, and different microclimates. It may also lead to an increase in the amount of time that it takes for a low-density stand versus a high-density stand to become susceptible to significant mountain pine beetle-caused losses. Schmid et al. (2007) and Olsen et al. (1996) suggest that thinning to 80 BA or less will reduce the competition between trees and reduce mountain pine beetle-caused mortality in lodgepole pine.

Size of a partial-cut unit is also important. Over the long-term, larger units will sustain less mountain pine beetle-caused mortality. The long-term solution to mountain pine beetle management is to create a mosaic of species, size, and age classes of stands across the landscape. This can be accomplished through silvicultural treatments and fire, natural and prescribed. Any treatment that lowers the stocking density, plurality of pine or average stand diameter will result in less beetle-caused tree mortality during an outbreak. Reducing the susceptibility of high hazard stands through silvicultural treatments can reduce the susceptibly of surrounding low and moderate hazard stands within a drainage (MFO-TR-13-02).

Forest Health Protection entomologists recommend variations of thinning treatments including diameter-limit cuts, basal area reductions, and spaced thinning that optimize effects of microclimate, inter-tree spacing and tree vigor (MFO-TR-13-02). Spaced thinning creates wider space between residual trees to improve tree vigor and create stand conditions detrimental to beetle survival. Cole et al. (1983) reported that 26.5% of trees were killed by mountain pine beetle in unthinned control plots versus <3% in four thinning treatments. McGregor et al. (1987) also found thinning significantly reduced losses due to mountain pine beetle and no significant differences between three thinning treatments. However, Preisler & Mitchell (1993) found that thinned plots were initially unattractive to beetles but when large numbers of attacks occurred, colonization rates were similar to those in unthinned plots. Schmid and Mata (2005) found that a single stand or a few stands within an unmanaged landscape may not provide long-term reduction of mountain pine beetle-caused tree mortality in the cut stands. They suggest that reductions in long-term tree mortality may occur when a sufficient area is managed so partially cut stands are separated from unmanaged stands by natural buffers or treated stands.

When preventive thinning cannot be accomplished or is delayed, there are a host of suppression actions that may reduce the level of beetle-caused mortality in the interim. The more infested trees removed during treatment, the greater reduction in infestation intensity the following year (Nelson et al. 2006). They also found that single-tree treatments (removing individual infested trees) were effective when infestation intensity was low to moderate in the treated and surrounding areas and when applied intensively throughout the area. During any stand treatments over the next few years, mountain pine beetle infested trees should be removed. Removal of infested trees increases the effectiveness of preventive thinning and any suppression methods that might be implemented. "Daylighting" around larger ponderosa pines would also reduce individual tree susceptibility to mountain pine beetle. Mountain pine beetle often prefers to attack and kill the mid-size diameter class in ponderosa pine stands initially, before it attacks large and very large trees. FHP suggests delaying underburning until the residual basal area has been further reduced or there is no longer a mountain pine beetle threat in the area.

When thinning in ponderosa pine, *Ips* beetle mitigation must be addressed. To reduce the impact of *Ips* in ponderosa pine slash, all treatments that result in substantial amounts of pine slash should be conducted between July and December. If this isn't possible, *Ips* mitigation measures should be in place prior to treatment.

Although mountain pine beetle activity appears to be declining, additional tree mortality may occur in stands with higher stocking densities. The basal area of stands visited ranged between 120-180 square feet per acre. For ponderosa pine, stands with basal areas exceeding 150 square feet per acre and average diameters greater than 8" are considered highly favorable for mountain pine beetle outbreaks (Schmid et al. 2007). Also, weather patterns over the next few years will partly determine future mountain pine beetle trends in the Lake Como area and on the Bitterroot National forest (MFO-TR-13-02).

Douglas-fir Bark Beetle (*Dendroctonus pseudotsugae* Hopkins)

Douglas-fir bark beetle (DFB) is an aggressive beetle that also causes tree mortality. It generally attacks Douglas-fir greater than 14"DBH in mature, dense stands. It also attacks smaller trees when DFB populations are very high (Negron et al. 1999). Douglas-fir bark beetle populations can be triggered by other events such as wildfire, windstorms, and climatic stressors such as drought.

Within the project area, there is some DFB activity. Aerial detection flights in 2003 had few polygons outside the project area averaging 17+ fader trees per polygon. The 2005 aerial detection map had a tremendous increase in the number of fader trees, averaging 5-10 trees per acre. Much of the mortality is more than 3 years old and new attacks from 2010 were infrequent. Unlike previous years on the Bitterroot National Forest, the project area, as well as areas adjacent to it, appears to have endemic levels of DFB activity. During field reviews, many of the tree crowns that were red in 2006 were less evident in 2007.

Tree mortality is greatest in Douglas-fir or mixed-species stands that are mature to over-mature, densely stocked, and of a high percentage of Douglas-fir. Douglas-fir beetle predation plays a role in forest succession. When beetle populations are low or in forests containing minor amounts of Douglas-fir, the beetle will attack the larger-diameter Douglas-fir, particularly those weakened by other agents, effectively weeding out the mature trees. On Douglas-fir habitat types in a seral phase there is a majority of ponderosa pine, lodgepole pine, or western larch, and minor amounts of Douglas-fir, the effect of the beetle would be to remove the Douglas-fir and maintain the seral species. If Douglas-fir is the dominant tree species, the loss of scattered small groups or individual mature Douglas-fir creates openings. On grand fir, cedar, subalpine fir habitat types where Douglas-fir is seral, the Douglas-fir beetle creates openings for the more shade-tolerant species to grow moving the forest to climax condition (Negron et al. 1999). Bark beetle outbreak prevention is best accomplished by reducing hazards associated with one or more of the risk conditions (host size, age, occurrence, and stand density) (Hood et al. 2007).

The Douglas-fir beetle has consistently been associated with fire-injured Douglas-fir, often attacking larger trees with moderate to high levels of bole injury (Furniss 1965; Rasmussen et al. 1996; Weatherby et al. 2001) and light to moderate levels of crown injury (Cunningham et al. 2005; Peterson and Arbaugh 1986; Ryan and Amman 1994; Weatherby et al. 2001). Additionally many coniferous species have life history traits and characteristics that enhance their resistance to injury from fire, thereby increasing post-fire survival rates (Hood and Bentz 2007). Larger Douglas-fir does have the capability to tolerate fire due to its thick insulating bark that develops with age and protects the inner cambium (Fowler and Sieg 2004). However, mortality following fire, not only depends on tree species, but also on type and degree of fire-caused injuries, initial tree vigor, type and intensity of fire and post-fire environment (Ryan and Amman 1996).

Models have been developed to predict DFB impacts from prescribed burning and post-fire management after a wildfire. Models developed by Hood and Bentz (2007) predict Douglas-fir mortality and beetle attacks within four years post-fire in areas dominated by Douglas-fir in the Northern Rocky mountains. These models are intended to be a part of the planning process in Douglas-fir forests and managers should augment their decision criteria with information on many factors, including location of population centers of DFB, tree physiological factors, overall stand health, and management objectives (Hood and Bentz 2007). These models are used as a guide to manage treatment objectives and reduce DFB effects on the forest.

<u>Root Disease</u>

Armillaria Root Disease (*Armillaria ostoyae* (Romagn.) Herink)

In May 2013, FHP Pathologists visited sites in the project area where root disease was detected in an aerial photograph (Figure 3.1- 12). They confirmed the root disease was *Armillaria ostoyae* (Romagn.) Herink. *Armillaria ostoyae* (Armillaria) was observed in a recently dead 12” DBH Douglas-fir and an 8” DBH subalpine fir with mortality evident throughout the stand.

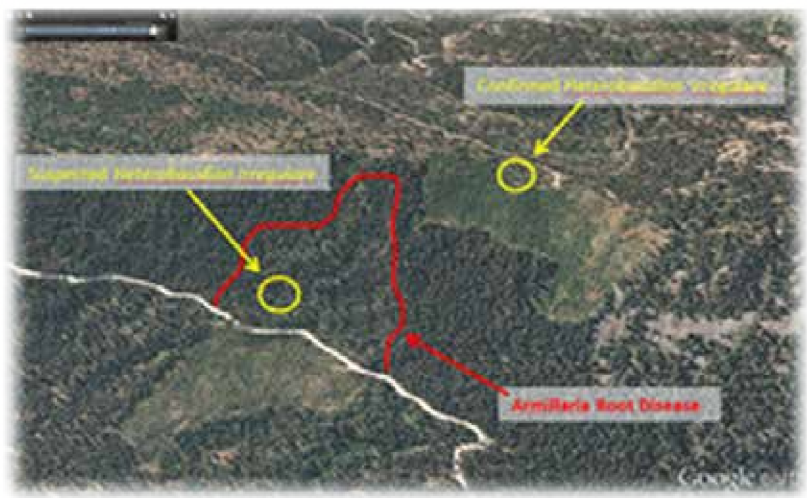

Figure 3.1- 12: Delineation of Armillaria Root Disease and Proximity of Suspected Heterobasidium Irregular in Lost Horse Creek Stand 7601002 to Confirmed H. Irregular.

Heterobasidium irregulare (annosus root disease) was also suspected due to the thinning crowns in ponderosa pine greater than 35” DBH; however, digging revealed only brown cubical decay in a dead taproot. This tree was probably infected by the extensive A. ostoyae inoculum and possibly *Phaeolus schweinitzii*. Although we didn’t find characteristic decay of H. irregulare in this tree, only a small portion of the root system was excavated and this pathogen was confirmed within ½ mile during an Elytroderma study, as well as FHP site visits (Lockman and Hartless 2008; Lockman 2003; Egan and Lockman 2011). Given crown symptoms, there is a good possibility that annossus is present.

Armillaria root disease should be considered a "disease of the site." Established mycelia of *Armillaria* are essentially permanent, so the best management option for minimizing losses is to manage for tree species that are most tolerant to the disease. In general, Douglas-fir and true firs are the most susceptible species in the Inland Northwest, and pines, western larch and cedar are the most tolerant. Tolerance and susceptibility are not finite characteristics, but exist as a continuum. It is important to observe how the disease is behaving on site, and what species appear to be most susceptible and most tolerant. It is also important to know that even tolerant species can succumb to Armillaria root disease when under great stress such as from drought, over stocking, or growing under the presence of large amounts of root disease on site.

Intermediate harvesting in stands with root disease and dominated by Douglas-fir will likely exacerbate the root disease on site. The Northern Region has monitored two sets of permanent plots for about 23 years. These plots are monitored to determine the effects of commercial thinning on root disease. In one set of plots monitored for 22 years (unpublished data), the volume of Douglas-fir decreased by 25% in the control plots and 31% in the thinned plots and the 10-year mortality rate for Douglas-fir was 30% in the control plots and 35% in the thinned plots. In other words, thinning did not improve the survival or increase the volume of Douglas-fir, even when the most vigorous trees were retained. In this same study, grand fir had a low mortality rate for the first 15 years but the rate nearly doubled between 15 and 22 years. This same trend is reflected in tree volume. Grand fir volume increased in the first 15 years, and then declined rapidly, ending with a net volume loss 22 years after thinning. Grand fir appears to respond positively to thinning in the short term, but the mortality eventually becomes comparable to that found in Douglas-fir.

In the second set of plots (Hagle 2006), the volume of Douglas-fir decreased by 36% in the control plots and 33% in the thinned plots. Although there is not much difference between these mortality rates, these two rates are not very different; thinning did not increase the volume of Douglas-fir as would be expected in the absence of root disease. In this same set of plots, the mortality rates for grand fir in the thinned plots were higher than in the unthinned plots. These results vary, but it appears that thinning does not improve the survival of remaining Douglas-fir or grand fir.

Morrison and Mallett (1996) report that in British Columbia, Canada, "partial cutting on sites with even a low background level of root infection by *A. ostoyae* increases the incidence of infection and mortality in residual trees." A more recent paper from British Columbia, Canada demonstrated an increase of root lesions on diseased trees from *A. ostoyae* after selective cutting on four sites, but was only statistically significant on two sites (Morrison et al. 2001). Results from this same study suggest *A. ostoyae* not only moves from the stumps of previously infected trees to neighboring trees, but may also move from infected stumps to cut stumps of previously uninfected trees. This has also been demonstrated in a study done in Australia looking at the occurrence of *A. luteobubalina* Watling & Kile after partial cutting (Kellas and others 1987).

Annosus Root Disease (*Heterobasidion annosum* ((FR.) Bref.))

This root disease is widely distributed in North America, and harvest practices have increased its incidence and impacts (Rippy et al 2005). The disease is spread by the fungus *Heterobasidion annosum* ((FR.) Bref.). Its primary mode of spread is by airborne spores landing on fresh cut stumps. The spores germinate and colonize the wood if conditions are favorable (Lockman 2006). The disease can also spread across root contacts if the neighboring tree is a susceptible species (Lockman 2006). This root disease often occurs in stands with other root diseases so root diseases are treated as a complex with the management recommendation of promoting root disease tolerant species. Ponderosa pine is the main host for the p-type annosum and design features would be applied to prevent annosus spread (Chapter 2). Fresh cut stumps of ponderosa pine, greater than 12 inches in diameter, would be treated with a borate compound, which prevents the germination of annosus spores on the stumps (Lockman 2006). Also, preventing damage to residual trees during harvest would greatly reduce the incidence of annosus infection (Rippy et al. 2005).

Schweinitzii Root and Butt Rot, (*Phaeolus schweinitzii)*.

Infection of Douglas-fir by *Phaeolus schweinitzii* (P. *schweinitzii)* predisposes trees to attack by Douglas-fir beetles, and also to infection by Armillaria root disease. The presence of *P. schweinitzii* in the project area warrants caution with regard to thinning. *P. schweinitzii* causes decay in the heartwood of roots and the butt of the tree. This decay decreases the uptake of water and greatly compromises structural roots, causing infected trees to be more susceptible to failure. Thinning frees up resources for the residual trees, but thinning also removes the protection from wind offered by crowns of neighboring trees. Thus, remaining trees are more susceptible to breakage and wind throw during wind events. Douglas-fir seems to suffer the most damage from this butt rot, but all conifer species are susceptible.

Heterobasidion Root Disease (*H. occidentale*) of Spruce, Fir, and Douglas-fir.

Although FHP Pathologists highly suspect *H. occidentale*, was present they were not able to confirm its presence in a spruce tree in Lick Creek Stand 7702112 within unit 57. The current recommendation is to minimize species on site that are most susceptible to *H. occidentale*, which in this case is Engelmann spruce, subalpine fir, and to some extent, Douglas-fir. Management recommendations for Armillaria root disease discussed above correspond with management recommendations for Heterobasidion root disease. We do not currently recommend treating stumps for the prevention of *H. occidentale*, unless in a high value site such as a campground, where individual tree survival is critical.

<u>Miscellaneous Insect and Diseases</u>

Western Spruce Budworm (*Choristoneura occidentalis* Freeman)

Western spruce budworm is an native insect and normally exists at endemic levels in the forest landscape. The larvae consume buds and foliage of Douglas-fir, subalpine fir, and spruce. They also feed on larch and pine when outbreaks are severe. Cones and seeds are also destroyed. Tree growth can be reduced after several years of heavy defoliation. After four to five years, branch dieback, top kill and tree mortality can occur.

Good budworm habitat consists of dense, multiple layers of host species. The upper canopy provides a good food source and refuge from predation, while the lower canopy intercepts budworm spinning from the upper layers and provides sanctuary from predators on the forest floor. The dense stand structure may also favor budworm survival by limiting the diversity of bird predators (Langelier et al. 1986) and reducing efficiency of some insect parasites.

Western spruce budworm has co-evolved with the forests of the Northern Rockies, and regular population fluctuations have always occurred. High population levels of the budworm would periodically occur, largely influenced by climatic conditions. Though climate may influence the probability of an outbreak, stand conditions will determine the duration and intensity. Several studies have found that the intensity and duration of budworm outbreaks have increased over the past 50-100 years (McCune 1983; Stipe 1982; Blais 1983; Carlson et al. 1983, and Anderson et al. 1987). It is probable that this change has come about largely because of past partial cutting and fire suppression practices, which has changed stand structures and species composition at the stand and landscape level (Schmidt 1985; Wulf and Gates 1987). Spruce budworm now has far more area of desirable dense, multi-canopied Douglas-fir forest available.

Although western spruce budworm has historically been the most prevalent insect defoliator in the Northern Region, the current outbreak has been building since 2000. In the Northern Region in 2000, 440 acres of visible defoliation were observed on the Helena NF. In 2001, the infested area grew to 1,300 acres—and the outbreak has expanded since—to more than 879,000 acres in 2008, although less than 1,200 acres were recorded on the southern end of the Bitterroot NF (Gibson 2009).

Currently, there are infestations of western spruce budworm in the stands within and outside the project area. Many of the stands are of a structure and composition favorable to budworm activity and would be considered highly susceptible to infestation. However, western spruce budworm populations on the Forest are presently at relatively low levels, but appear to be increasing (Gibson 2009).

There are not a lot of management opportunities to reduce budworm populations in the short term. Long-term management of host stands to reduce impacts of defoliation are available; but are more effective when part of area-wide management plans (Gibson 2009).

Comandra Blister Rust (*Comandra umbellate*)

This disease is killing the tops of both understory and overstory ponderosa pine. The causal fungus needs two types of hosts to complete its life cycle. Spores from infected alternate hosts (bastard toadflax in our area (Comandra umbellata)) are released from midsummer to early fall. These spores are windborne and infect pine needles and shoots of hard pines, ponderosa, and lodgepole pines. The fungus then spreads into the inner bark, and after several years causes a diamond shaped canker. Spores from infected pines develop in late spring and summer and infect the alternate host, thus completing the life cycle. Outbreaks of this disease are sporadic, due to variations in the distribution of the alternate host and the periodicity of environmental conditions necessary for infection. The most serious damage has been observed in nurseries and plantations where rapid stem girdling results in high mortality. It is more common to find it acting as a topkill agent in older trees in our area. The recommended management tool is to select against infected trees during any entries.

Elytroderma Needle Blight (*Elytroderma deformans* (Weir) Darker)

The Lake Como area historically has had high levels of elytroderma needle blight in ponderosa pine (Lockman and Hartless 2008, Lockman and Jackson 2003). We observed light brooming in a number of trees, but did not see any trees with severe levels of infection. Ponderosa pine with elytroderma symptoms would be of high priority for removal in treatment areas. Trees with moderate levels of systemic infections (25-75% of the crown) are more prone to bark beetle attack. Low levels of infection (<25% of crown) appear to have minimal effect on the health of the tree, and severe infections (>75%) can kill the tree outright (Childs et al. 1971).

Management Options

Several silvicultural treatments could be implemented to reduce impacts of the various insects and diseases found in the project area. In stands with heavy infections of DFDM, thinning from below would reduce mountain pine beetle impacts in the pine portion of the stand but exacerbate DFDM. In stands with significant root disease, thinning from below could also exacerbate root disease. Therefore, in these types of units, regeneration harvests followed by planting of root disease tolerant and DFDM resistant conifers are recommended when volume production is the primary management objective. Creating larger openings in areas with high levels of DFDM can reduce long-term impacts and improve species diversity, which would be more resilient to insects and diseases over time. Group selection harvest or thinning from below would be used to reduce impacts of western spruce budworm when DFDM and root disease are not detectable or host species are a minimal component of the stand. In areas with pine or no detectable DFDM and root disease, thinning from below would be an appropriate treatment to reduce mountain pine beetle hazard. Creating a mosaic of age and size classes and species diversity is the best long-term solution to mountain pine beetle management.

Timber Harvest

In 1899 Leiberg stated, "The largest area in the main Bitterroot Valley covered with nearly solid and pure growth of yellow pine, lies between Roaring Lion Creek and Trapper Creek." He also noted, "Merchantable timber (16 inches in diameter at the butt) in the Bitterroot Valley, will not last many years at the present rate of consumption. The yellow pine within the Reserve could, with ease be logged off in five years. At a similar pace it is safe to say that less than twenty years would see all the merchantable pine in the valley converted into logs or lumber."

The Lick Creek sale of 1906 was the largest National Forest timber sale in Region 1 at that time. The largest timber sale of its time attracted the attention of the First Chief of the Forest Service, Gifford Pinchot who inspected the marking of the sale.

Most of the timber harvest, 2,464 acres, occurred in the 1960s and 1980s. Much of the volume was ground skidded in these decades and very little was yarded using skyline equipment (Refer to Soils analysis).

Timber harvest has occurred on 3,880 acres (69%) of the project area over 8 decades. Past harvest, from the 1900s to the present, include 1,997 acres of intermediate treatments (commercial thin, liberation, and sanitation/salvage); 365 acres of seed tree and shelterwood harvest; 292 acres of stand clearcut with and without reserves; and 1,226 acres of uneven-aged management. Table 3.1- 8 displays the areas of harvest by decade within the Como Forest Health Project area.

Intermediate harvests are several different types of treatment with the purpose to improve the tree species composition and not promote regeneration. Intermediate treatments selectively remove some trees to allow the expansion of crowns and roots of remaining trees. Five common types of harvest are associated with intermediate treatments: liberation, improvement, thinning, salvage, and sanitation (Wegner 1984).

Liberation harvests are designed to regulate the species composition or improve the growth of new stands. When trees removed are older than those released, it is called a liberation harvest.

Improvement harvests are similar to commercial thins, however they focus on improving species composition and forest health rather than improving growth. The objective is to improve the existing stands by featuring the largest diameter classes, promoting fire-resilient stands, and reducing the number of stems, without any effort directed at regeneration (Smith 1962).

Salvage harvest is the removal of, dead, dying, damaged, or deteriorating trees while it is merchantable.

Sanitation harvest is the removal of trees, as well as those susceptible to attack, with the purpose of reducing the spread of insects and diseases. Many times salvage and sanitation harvests are combined.

Uneven-aged management is creating or maintaining three or more distinctively different age classes. Selection is achieved by groups or by single trees. Under the selection system, the stand always has some trees represented from various age classes, late seral to seedling. New regeneration is established by periodic partial cuttings. Either selection type requires regular entries into the indefinite future.

3.1.2.2 Desired Condition

The legacy of past management practices, harvesting, fire suppression, and the changes in vegetative tree species composition and tree densities over time, explains why the current need is to reduce fuel and stocking levels. Cumulative changes now place the current vegetative conditions at risk of fire or insect and disease events. The lower elevation ponderosa pine and Douglas-fir cover types are especially at risk since these fire regimes have been altered the most. The majority of vegetation treatments proposed in the project area are located in lower elevation ponderosa pine and Douglas-fir.

Desired Conditions within a VRU

The purpose and need for the Como Forest Health project is focused specifically on:

- improving tree resilience to mountain pine beetle
- reducing tree densities in both young, regenerated timber stands and mature stands
- improving forest resilience to disturbance
- reducing fuel loads and maintaining prescribed fire throughout the project area.

The following conditions are options the Silviculturist considers in prescribing treatments to shift the landscape within the VRUs towards a more desirable and sustainable condition. The landscape attributes are achievable under average conditions and are based on applied research, scientific findings from the Interior Columbia Basin Ecosystem Management Project (ICBEMP), and local forest conditions. While there is considerable information presented on historic forest conditions, the emphasis is on sustaining the biological processes that produce these conditions. The extent and scale of vegetation management depends on project level resource objectives. Where vegetation management is used to move towards desired landscape conditions, most silvicultural systems are applicable.

The desired stand conditions are formulated to achieve project objectives. Similar VRUs are combined when they represent a small part of the project area (Table 3.1- 1). The desired landscape conditions are broken into categories within the VRU such as vegetation, ecosystem health, fire, fuels, and habitat features.

Vegetation Response Unit 1 and 2:

Forest structure has a primary influence over ecological function and ultimately the inherent biological diversity. Frequent disturbance processes are largely responsible for the forest structure that has developed in this vegetation response unit. Stand structures and the distribution of trees are also strongly influenced by the soil type and other physiographic features. As a product of frequent low to moderate severity fire and occasional stand replacement events, these VRUs are generally a mosaic of stand ages and forest types.

Vegetation:

- Mosaic of stand conditions such as stocking, age class, and species composition relative to historic range of seral and climax tree species
- Within the VRU strive to maintain 15-25% seedling/sapling, 15-35% pole, 10-30% mature, and 20-50% over-mature structural stages based on ICBEMP scientific findings (USDA, 1996)
- Largely multi-storied and two-aged dependent on forest type
- Stands are dynamic and harvest will continue to be needed at regular intervals to reduce densities and create openings to favor regeneration of ponderosa pine
- Species composition of approximately 70 - 85% ponderosa pine and 15 - 30% Douglas-fir
- Stand density relatively low, between 40 – 80 BA (ft^2/acre), depending on aspect

Fire/Fuels

- Create small openings (2-5 ac) within an irregularly shaped, treatment area (20-200 ac); to emulate variation that occurs from mixed severity fires
- Average fuel loading generally ranges from 5-15 tons per acre
- Non-uniform, relatively open community of late seral ponderosa pine and Douglas-fir sustained through prescribed fire and timber harvest at frequencies consistent with natural fire returns
- Implement prescribed fire at regular intervals across the landscape
- Desired forest structures reflect the product of frequent low to moderate severity ground fires
- Create space between overstory tree crowns to reduce the potential spread of crown fire in the overstory.

Ecosystem resiliency/Habitat Features:

- Maintain key cover areas for dependent wildlife. Maintain wildlife travel corridors to provide connectivity between habitat features
- Retain existing snags, broken-topped live trees, and down logs to provide for a variety of wildlife species
- Maintain tree health, vigor, stocking, species, and age class diversity
- Thin denser, overstocked stands of trees, favoring early seral species as much as possible

- Retention of large diameter trees as snag replacements and seed sources as they represent a unique component of the VRU that typically survived low severity fires

Vegetation Response Unit 3 and 4:

This VRU is composed of moist, cool grand fir habitat types, which occurs on benches, ravines and reflects the influence of the inland maritime climate affecting forest development and the role of fire. These VRUs are transitional including characteristics of surrounding VRUs such as VRU 2 and VRU7.

Vegetation

- A mosaic of stocking levels, age class distribution and species composition would exist representing varied structural attributes. Appear as a mix of open stands with large diameter overstory and well stocked stands of mixed conifers
- Generally, stand density is moderate, between 80 – 140 BA.
- Within the VRU strive to maintain 15-25% seedling/sapling, 20-40% pole, 15-35% mature, and 15-40% over-mature structural stages based on ICBEMP scientific findings (USDA, 1996)
- Species mixture should include 70 - 90% Douglas-fir and lodgepole pine and 10 - 30% other species
- A variety of successional stages relative to historic ranges of seral and climax species. Relatively open, single storied, late seral conditions would be expected on ridgelines. Multistoried, late seral conditions on gentle slopes and riparian areas

Fire

- Desired forest structures would reflect conditions of both non-uniform mixed severity fires and infrequent stand replacement fires
- Where ponderosa pine and Douglas-fir are dominant seral components, maintain historic fire frequency using prescribed fire or prescribed natural fire. Promote the development of fire-adapted species
- In moist grand fir habitat types, the use of prescribed fir would be imitated as part of a fuel treatment following a regeneration harvest
- Average fuel loading generally ranges from 10-20 tons per acre

Ecosystem resiliency/Habitat Features:

- Maintain tree health, vigor, stocking, species, and age class diversity
- Maintain key cover areas for dependent wildlife, maintain travel corridors to provide connectivity between habitat features
- Retain snags, broken topped live trees, and down logs
- Natural fires, root disease, and periodic bark beetle mortality provide conditions for cavity habitat
- Where old growth forest character is desired, stands should be located in settings representative of their functional purpose
- Maintain thermal cover, particularly along riparian areas by retaining shrubs and dense canopy cover where snow depth may be restrictive

Vegetation Response Unit 7:

This VRU occurs in the moist, lower subalpine forest setting, and is common on northwest to east facing slopes, riparian, and poorly drained subalpine sites in the Como Forest Health project area.

Vegetation

- Generally, stand density is moderate in treated stands between 80-140 BA
- A variety of successional stages relative to historic ranges of seral and climax species, mostly even aged single storied and some two storied stands
- Within this response unit strive to maintain 15-25% seedling/sapling, 20-40% pole, 15-30% mature, and 15-45% over-mature structural stages based on ICBEMP scientific findings (USDA, 1996)

Fire

- Desired forest structures would reflect conditions of both low severity fires and infrequent stand replacement fires of the moist lower subalpine habitat types
- Maintain historic fire frequency using prescribed fire or prescribed natural fire.
- Promote the development of fire-adapted species
- Average fuel loads generally range from 12-25 tons per acre

Ecosystem Resiliency/Habitat Features

- Relic overstory would be left as aggregates or dispersed through the stand wherever possible
- Maintain tree health, vigor, stocking, and species and age class diversity

<u>Vegetation Response Unit 9:</u>

Vegetation

- Generally, stand density is moderate in treated stands between 80 – 140 BA
- A mix of even and multi-aged stands of mainly of shade tolerant trees: subalpine fir, Engleman spruce, Douglas-fir, and lodgepole pine with stocking ranging from fairly open to dense with a mix of even-aged lodgepole pine stands
- A variety of structural stages based on ICBEMP findings (USDA, 1996) indicates 20-40% in seedling/sapling, 40-60% in pole, and 15-20% in mature across the vegetation response unit

Fire

- Desired forest structures would reflect a mosaic of stand conditions similar to conditions created naturally by frequent low severity and mixed severity fires, and low to moderately extensive stand replacement fires as discussed for fire Group 8 in dry lower subalpine habitat types
- Create small openings, less than 5-10 acres to mimic canopy gaps from mixed severity fires
- Use prescribed fire where possible to maintain sustainable fuel conditions within historic ranges
- Average fuel loads generally range from 12-25 tons per acre

Ecosystem Resiliency/Habitat Features

- Retain large diameter reserve trees that are important as snag replacements and seed sources since many snags are typically small diameter because the prevalent species are lodgepole pine and subalpine fir
- Connectivity is relatively high and largely attributed to large patch size providing hiding cover
- Maintain serotinous cone lodgepole pine ecosystem by maintenance of fire
- Maintain tree health, vigor, stocking, and species and age class diversity

It is also important to ensure that potential treatments will result in a healthy and sustainable condition in the forest and ecosystem. The desired conditions should be within the range of natural variability – that which we might expect under natural disturbance and succession regimes. The desired future condition includes forest structures, composition, and processes that would have been present historically. Fire plays an important role in the sustainability of these ecosystems. Prescribing timber harvest or understory thinning in advance of prescribed fire allows fire to be reintroduced into the project area without causing high levels of tree mortality. Additionally, timber harvest is not prescribed to replace prescribed burning. They are being analyzed jointly in each of the alternatives; the effects of timber harvest followed by prescribed fire are described in each of the effects sections. Prescribed fire will reduce the vulnerability of the forest to possible severe and undesirable effects from wildfire, insects, or disease. It creates a resilient forest in the face to inevitable change and future uncertainties, and provides for a wide variety of resource and management needs. A resilient forest is one that has the ability to withstand and maintain normal function through natural disturbances, such as fire, insects, disease, or climate change. Harvesting would be designed to maintain the larger diameter trees and create varied age and size classes across the landscape.

Quaking Aspen (Populus tremuloides)

At a landscape scale on the Bitterroot NF, aspen and other Populus species such as cottonwood are not well represented by numbers or percentage of area. Although there is very little documentation on historic coverage of aspen or cottonwood on the Bitterroot NF, one would expect that they have declined particularly in numbers of young stems. The site characteristics of cottonwoods are often wet and they are more of a riparian species compared to aspen which is found in upland areas and drier sites. The regeneration processes of Populus species can be sexual and asexual. Most regeneration in established forests is asexual, by root suckers or coppice sprouts (Stettler, et al. 1996). This is commonly referred to as clone, which is defined as shoots or stems that sucker from the interconnected root system and produce new stems that are genetically identical (Jones and Debyle 1985).

The presence of aspen, and the biodiversity and habitat it provides, is very important at a landscape scale and it is desirable to maintain its presence or increase it. Since the fires of 2000, the amount of aspen has expanded and young aspen stands are developing (regenerating) in many areas from clones.

Aspen is considered a keystone species; a species that affects the survival and abundance of many other species in the community in which it lives. With the exception of riparian areas, aspen communities are considered the most biologically diverse ecosystems in the Intermountain West (Kay 1997, in Sheppard et al. 2001). Wilson (1992, in Sheppard et al. 2001) states, "In communities there are little players and big players, and the biggest players of all are the keystone species."

Maintaining healthy aspen stands increases the vegetation diversity in the project area. To achieve this vegetation diversity, the age and size class diversity of aspen stands needs to increase. Removing conifer overstories removes the shade that suppresses the growth and development of the aspen clone. Releasing aspen from the shade of the overstory promotes clone regeneration and improves the size class and age diversity of the clone.

Reserve trees and two-aged systems are used to create structural diversity in aspen clones. These systems provide a range in both age and size class. Aspen clones with low levels of insects and diseases reduce the risk of losing the clones. Vigor, to some degree is a factor of age. Some decadence is desirable, particularly when overstory aspen are retained to enhance structural diversity or create a two-aged system. Young stands of aspen do not tend to exhibit uniform spacing. This degree of aggregation diminishes with age; however, populations tend to remain highly aggregated. Thus, the density across the clone varies, which is natural and desirable.

3.1.3 Environmental Consequences

3.1.3.1 Methodology

Summary

This summary compares alternatives based on the purpose and need in Chapter 1 and desired conditions of vegetation in section 3.1.2.2. A summary of treatment differences between alternatives can be referenced in Table 3.1-7.

Alternative 1 is the no action alternative and no stand treatments would occur. Forest stand density would continue to increase and facilitate the growth of mountain pine beetle populations. Alternative 1would not meet the purpose and need of improving forest resilience to mountain pine beetle infestation or reducing the potential for beetle-caused tree mortality in large ponderosa pine, or reduce fuel loads to maintain historical fire return intervals.

Alternative 2 treats the most area; however the Lick Creek research units in the center of the project area are not treated nor are the aspen units. This alternative also proposes to treat 138 acres of mixed conifer old-growth with uncertainty of keeping them in an old-growth condition. It also proposes 1,032 acres of prescribed fire without pre-treatment of fuels. These areas may burn hotter than historic fire severity.

Alternative 3 treats 155 fewer acres than Alternative 2 and does not treat the aspen units or the pine stands east of the BRID. However, it does treat the Lick Creek research areas, mixed conifer old-growth, and many of the north slope units identified in Alternative 2. Unit E is proposed for prescribed burning, which may burn hotter than anticipated because of the dense fuels and low canopy base height.

Alternative 4 treats 1,207 fewer acres than Alternative 2 but it does not burn Unit E (371 acres), treat mixed conifer old growth units (138 acres), or areas of hiding or thermal cover. Alternative 4 treats pine units east of the BRID and the Lick Creek research units. This alternative treats the most ponderosa pine of any of the alternatives and has the most non-commercial thinning combined with prescribed fire. The units proposed for prescribed fire are within historic fire severity, which would cause less tree mortality. The north slope units are not treated and are left for wildlife cover.

Stand Diagnosis

A stand diagnosis is the preliminary documentation of existing stand and site conditions. The stand diagnosis includes such items as slope, aspect, elevation, land type, habitat type, vegetation characteristics, access concerns, and potential logging concerns. Desired vegetation conditions and treatment options are recorded, and a preferred treatment selected. Diagnoses were made for individual stands, as well as, proposed treatment units, which may be composed of several stands. Detailed stand exams or walk-through exams were started in the summer of 2009 for all commercial treatment units and were completed in the fall of 2013. Information used in the diagnosis was gathered from various sources and a variety of ways including aerial photographs, 'walk-throughs', stand exams, and data from past stand exams (Timber Stand Management Record System (TSMRS) data base).

Primary Use in Analysis

Primary use in this analysis was for developing the proposed action and alternatives to the proposed action, as well as developing preliminary treatment options and prescriptions.

Core Assumptions and Limitations

One limitation of this data is that during the initial walk-through or stand exam, not every piece of ground or every piece of each stand is covered. Conditions could exist that are not represented by the data. However, by using aerial photographs, TSMRS data, and field knowledge, the Bitterroot National Forest Silviculturist could account for most unique conditions in the diagnosis.

Anticipated Consequences of Limitations

Diagnosis is one-step in the process that leads to the silviculture prescription for proposed treatments. Data collected during the diagnosis phase is preliminary and iterative. As more in depth fieldwork occurs, diagnosis information is updated and refined in preparation for treatment prescriptions.

Timber Stand Management Record System (TSMRS)

TSMRS is the database where stand data needed to manage the timber resource is recorded (USDA Forest Service 1996e). This record system stores the historical data of all stand treatments, and provides information for silviculture prescriptions, treatment plans, and schedules used in required reports and to update and amend the Forest Plan. The data is collected in a variety of ways, including field surveys and aerial photo interpretation. The usefulness of the system is directly proportional to the reliability and completeness of the data entered. Timber resource managers regularly update the data.

Primary Use in Analysis

TSMRS data is used to understand habitat types, forest cover types, and forest structural stages. The Forest Activity Tracking System (FACTS) tracks stand activities such as past harvest, site preparation, planting and timber stand improvement (thinning). This data provides the record of activities that have occurred in the project area and are filed in the project file (PF-SILV-004).

Core Assumptions and Limitations

The TSMRS is made up of three components: an Index Map, a Stand Folder, and an Automated Data Base. All three components function together; the index map is the primary index for all stands in the system, the stand folder contains all the detail needed for management; and the data base allows the compiling and summarizing of information.

The stand is the basic unit for record keeping. While stand size and shape may change, every stand number is unique. A new stand can be delineated where none was previously recognized or defined as a smaller part of an existing stand or stands. In this analysis, similar stands with similar habitat types were combined for treatment prescriptions.

Some data was gathered using formal stand exam protocols, which have a corresponding statistical analysis. Compartment exams, done by aerial photo interpretation and walk-throughs are other ways data were collected, though they are not statistically as accurate as formal stand exams. These types of data collection depend on individual interpretations and the expertise of the individual.

Anticipated Consequences of Limitations

TSMRS is not a spatial database. This means that treatments that occur in a portion of the stand are not delineated in the stand but are shown as occurring over the whole stand. Showing treatments on a map then displays the entire stand instead of the portion treated. While the correct area of the treatment can be tabulated, the spatial location of that treatment cannot be displayed.

TSMRS was implemented in the late 1980s. Historical activity data prior to the late 1980s may not be as complete and accurate as those data entered later. Currently, parts of the TSMRS database have been replaced by FACTS. However, since very little recent or ongoing activities have occurred in the project area, TSMRS data is relevant for use in this project. TSMRS data gaps were considered and filled using aerial photo interpretation and verified with walk-throughs or stand exams. Most of the data gaps were outside the treatment areas and are relevant to the analysis at the landscape level but were not important for predicting site-specific treatment effects.

We did not rely exclusively on TSMRS data in the development and analysis of the Como Forest Health project. Ongoing field visits since 2009 by Interdisciplinary Team (ID Team) members provide first-hand knowledge of the project area, and TSMRS data provides supporting information.

3.1.3.2 Alternative 1 – No Action

Direct and Indirect Effects

There would be no direct effects on vegetation in the short term. The area would continue to change with natural forces determining stand conditions. The composition of the stand would change in direct relation to future disturbances. Ecosystem processes would continue and forest composition would change in direct relation to them. However, forest conditions would likely be very different from what they were historically. The potential natural vegetation in the project area is Douglas-fir, grand fir, and subalpine fir. Although this is the theoretical climax forest, it is not what existed historically in the ponderosa pine cover types because periodic fire maintained the seral species mix and structure. Eventually, fire would burn these stands.

While insects and pathogens are an inherent part of the forest, changes in stand composition, density, and structure would create additional concerns that relate to ecosystem resiliency and maintaining biological function. Dense, multi-storied stands are susceptible to and capable of supporting populations of western spruce budworm and dwarf mistletoe infections. The basal area of ponderosa pine stands range between 120-180 square feet per acre. Ponderosa pine stands with basal areas exceeding 150 square feet per acre and average DBH greater than 8 inches are highly susceptible to mountain pine beetle outbreaks (Schmid et al. 2007). Without treatment, bark beetle-caused mortality is anticipated to continue and gradually increase over the next few years at incipient to epidemic population levels, assuming similar environmental conditions to 2009 and 2010. Mortality at incipient to epidemic levels typically ranges from pockets of 5 to 25 trees per group. Year-to-year mountain pine beetle-caused mortality rates at this population level can remain constant or increase two-fold (Safranyik and Carroll 2006). Flight dispersal distances of mountain pine beetle are variable; however, mountain pine beetles often attack adjacent trees (within 180 feet) after emerging from trees attacked the prior year (Robertson et al. 2007). Overall, 30% or more ponderosa pine mortality would be expected without treatment assuming conditions remain favorable for beetle reproduction and host colonization (Gibson 2008). However, conditions that influence beetle-caused mortality fluctuate annually and may change rapidly.

The Como Recreation Area was recently treated and mountain pine beetle-caused mortality within the area has declined. However, studies by Schmid and Mata (2005) found that a single stand or a few stands treated within an unmanaged landscape may not provide long-term reduction of mountain pine beetle-caused mortality. They suggest that reductions in long-term tree mortality may occur when a sufficient area is managed and partially cut stands are separated from unmanaged stands by natural buffers or treated stands. Without a landscape approach to treating stands, the Como Recreation Area could see an increase in mountain pine beetle-caused mortality, which would not be desirable.

Past regeneration units would not be thinned. Many of these forest plantations have successfully regenerated into high-density stands. These areas are too dense to achieve optimal growth rate and size. Without treatment, they may become suppressed and at risk of mountain pine beetle attack or stand replacement fire. The investment made to regenerate these plantations would be lost and the rotation would be set back.

Dense, continuous fuels will increase with the higher stand densities, decadence, and tree mortality. This increase fire hazard presents conditions resulting in higher fire intensity and a change from surface to crown fires (Monnig and Byler 1992).

In the absence of fire, shade-tolerant species such as Douglas-fir, grand fir and subalpine fir would increase. The multistoried stands of ponderosa pine and Douglas-fir are under stress from overstocking. Continuous, multiple vegetation layers of Douglas-fir with interconnecting crowns would continue to develop and increase the fire hazard. As stand structure becomes denser, so would competition for growing space and water. Inadequate growing space and water would increase tree stress and decrease tree resistance to insect and disease infestations. Ponderosa pine would decrease and eventually be replaced by shade-tolerant species. Fire-adapted native shrubs, grasses, and forbs would decline. These factors would continue to interact and create conditions highly susceptible to fire. Low-severity fires would be less likely due to the buildup of ladder fuels and downed woody material. Canopy gaps will occur due to mortality of individual trees and clumps of trees.

When fire does return to this landscape, it will most likely be of high severity. The fires of 2000 burned in similar stands with many of these same vegetative conditions. Much of the area had 70-100 percent tree mortality. The lack of seed, severe seedbed conditions, and competition from grasses and shrubs make regeneration extremely difficult. Invasive plants already present in the stands would increase relative to native species.

Cumulative Effects

Under the No Action alternative no stand treatments would occur. Current ongoing work under contract as well as work planned and analyzed under other decision documents would still occur. Fires would continue to be suppressed according to Forest Plan direction. Without active management, forest conditions in the long term would continue to deteriorate because stands would be overstocked and trees would be less resistant to insect and disease activity. Seral tree species would be slowly out-competed by more shade tolerant tree species. This would perpetuate the shift in species composition from species that were able to withstanding wildfires, insects, and diseases characteristic of historic conditions to those more susceptible to destruction if these events occur. Vegetation conditions over time would have a very high risk of destruction by the above disturbance events. These site factors create the eventuality of a stand replacement fire and the return to the stand initiation stage.

Vegetation that exists following a fire or other major disturbance is largely dependent on the intensity of the event, the vegetation that existed prior to the disturbance, the seed stored in the soil and the degree that natural regeneration is successful. While fire is important to plant community establishment, the above factors are largely responsible for post-fire succession.

If a stand replacing or mixed severity fire occurred, the resulting landscape would be similar to that which exists where the fires of 2000 burned the Bitterroot National Forest. Mixed severity fire events could lead to epidemic insect and disease population levels. Bark beetle-caused tree mortality could become significant following a large fire as was seen after the fires of 2000.

In addition, healthy trees in the beetle dispersal area can be mass-attacked as bark beetle population's increase in the low vigor and injured trees (Oliver and Larson 1996, Hessberg et al. 2004). These large-scale disturbance events, fire and beetles, would change the forest character with the resulting landscape condition persisting for a long time. Natural regeneration would take longer due to the lack of seed producing trees, and some areas may regenerate to a less ecologically desirable species. Active reforestation to establish site-adapted tree species may be limited if money to support such efforts is unavailable. Ecologically, this impact would occur most in ponderosa pine since it is the most seral tree species. Forest Plan Goals and Desired Conditions would not be met for decades.

3.1.3.3 Effects of Silvicultural Treatments Common to Alternatives 2, 3, and 4

This section describes the design features, mitigation measures, effects, and monitoring of silvicultural treatments that are common to the action alternatives 2, 3, and 4.

Design Features and Mitigation Measures Common to Alternatives 2, 3 and 4

Application of Borate

Borate would be applied to cut ponderosa pine stumps greater than 12 inches in diameter. Retaining ponderosa pine in the project area is an objective of this project. Ponderosa pine is also the main host for annosus root disease. Once this disease becomes established, there is no economically feasible treatment to directly suppress it. Preventing its introduction is the most efficient and economical way to reduce its impact (Lockman 2006). To prevent the spread of annosus root disease, the freshly cut ponderosa pine stumps would be treated with a borate compound, which would prevent the germination of annosus spores that land on these stumps (Lockman 2006). Preventing damage to the residual pine would also greatly reduce annosus root disease infection (Rippy et al. 2005).

The Forest Service completed a risk assessment of the use of borate or borax (USDA Forest Service 2006b). The toxicological agent is boron (USDA Forest Service 2006b). Boron occurs naturally in the environment, and exposure is unavoidable. Except for the most extreme exposure scenario considered in the risk assessment (the direct consumption of borate on a tree stump by a child), the use of borate will not substantially contribute to boron exposures in humans (USDA Forest Service 2006b). Health effects evaluations by the Forest Service have taken into consideration the potential for both worker and public exposure from this application. This information was used to formulate protective measures to reduce the risk to forest workers and the public (USDA Forest Service 2006b, Borax Pesticide Fact Sheet - Information Ventures, Inc. 1995, and the borate Material Safety Data Sheet and Label - Wilbur Ellis 1996). The use of borate in Forest Service programs will not increase boron concentrations in water or soil (USDA Forest Service 2006b). In addition, using borate to prevent the spread of annosus root disease is not a significant risk to wildlife species under conditions of normal use, even under the highest application rate (USDA Forest Service 2006b). Results from exposure scenarios indicate that aquatic animals and plants are not at risk (USDA Forest Service 2006b). Mitigation measures, such as riparian and wetland buffers, would greatly limit any accidental spillage of large quantities of borate into aquatic habitats.

Bark Beetle Considerations

Harvesting operations conducted during active beetle flight and within one mile of beetle epicenters may result in centralized tree mortality as beetles respond to semi chemicals released from processed tree material. During FHP visits, beetle populations adjacent to the project area did not appear high enough to warrant restricting operating periods. However, the visit occurred at the beginning of the beetle-flight period. If extensive beetle activity is observed in green-attacked trees within one mile of harvest units prior to logging, limiting timber harvest during the flight period in July and August would be considered.

Ips populations can increase in slash greater than 3” in diameter. They have multiple generations per year and emerge to attack adjacent pines. Populations increase most dramatically in slash created during spring logging operations, especially during warm springs with drought conditions. Mortality and topkill can occur when attacked trees are physiologically stressed from competition or drought conditions. Mortality typically occurs in pole-sized trees (less than 10”DBH) but has been documented in larger diameter trees during outbreaks (Shultz and Bedard 1987). Ips populations can also increase in conjunction with mountain pine beetle populations as increased host material becomes available within mountain pine beetle-attacked trees. FHP entomologists observed high levels of Ips in 2010 mountain pine beetle-attacked trees as well as slash created from spring 2011 management activities in various locations of the Bitterroot and Sapphire Mountains.

The most effective cultural practice to prevent Ips colonization is to avoid harvesting activities between December and June because it reduces the time Ips beetles have to complete their lifecycle. However, avoiding harvest during this period is not often feasible so the following methods would be used.

Lop and Scatter Slash Dispersal

Green slash exceeding 3” in diameter would be lopped into 2-3 foot lengths and scattered in areas with direct exposure to sunlight. Treating the slash in this way reduces Ips habitat quality because the slash dries out before the beetle brood can mature. All fresh slash and logs would be located several yards away from living trees.

Green-Chain of Host Material

Piling slash in large-sized piles can provide suitable host material in the middle of the pile that lures Ips deeper into the pile. Ideally, piles should be 10 x 10 x 20 feet in height x width x length.

Destruction of Infested Slash

Should small slash piles be constructed from December to June, infested material can be burned, chipped, or otherwise destroyed prior to beetle emergence in early July. Surveys of host material prior to July can indicate the risk of tree mortality or topkill to residual stems in treatment units. In high-risk areas where Ips mitigation options are limited, mass trapping of Ips with pheromone lures and Lindgren funnel traps may also reduce Ips-related damage to residual stems.

The silviculturist, wildlife biologist, and fuels specialist would conduct post-harvest exams before underburning units to evaluate the completeness of vegetation treatments.

Silvicultural Treatments Effects for Alternatives 2, 3 and 4

The alternative treatments change stand composition and structure through harvest and prescribed burning (Table 3.1- 5). The treatments prescribed for individual units are the same in each alternative; the differences between alternatives are the units proposed for treatment. There would be clear changes to forest composition, structure, and successional stages in treated areas. The alternatives propose to thin stands to reduce overstocking and favor more drought and fire resistant ponderosa pine. The treatment goal is to promote stand resilience to disturbance and stress factors, such as insects, disease, competition, and fire in the project area. The intent is to maintain insects and diseases at endemic levels and modify potential fire behavior. Proposed timber harvest followed by prescribed fire would create vegetative conditions where ecological processes interact as they have historically. Ecological processes such as wildfire are more severe now than they were historically (Hessburg et al. 1994, Steele 1993) and harder to contain and control, which increases the risks to lives and property.

The alternative treatments would improve forest resilience to insect and disease infestations, and fire. These proposed treatments would alter forest structure by increasing crown spacing, reducing stocking levels, and retaining large, fire-resistant trees species. Beneficial effects of the proposed treatments would be apparent for approximately 10-20 years. Though treatments would reduce stand densities and lower risks of insect and disease infestation, tree growth rates would dictate when the infestation risk level is reduced (Schmid et al. 1994). Reduction in stand densities would be an ongoing management practice in order to maintain forested conditions at a lowered susceptibility level.

Prevention of insect and disease infestations is a pro-active approach that changes forest conditions from being susceptible to insect and disease to being less susceptible. This pro-active approach includes modifying vegetative conditions through silviculture practices that reduce tree-to-tree competition and remove stressed or unhealthy trees (Romme et al. 2006). Prevention is geared to reduce the risk of an attack getting started in a forest stand (Romme et al. 2006). Forest management is unlikely to prevent all outbreaks because it is not feasible to intensively manage all of the forest and many factors are beyond our control such as drought and climate change.

Table 3.1- 5: Summary of Proposed Activities in the Como Forest Health Project by Alternative.

ACTIVITY	ALTERNATIVE 2	ALTERNATIVE 3	ALTERNATIVE 4
TOTAL COMMERCIAL HARVEST	**1,476**	**1,292**	**1,115**
Uneven-age Harvest (UEA) Total	638	488	342
Single Tree	342	326	342
Group Selection	296	162	0
Intermediate Treatments (Improvement Cut)	838	804	773
Aspen	0	0	39
Old-growth	187	143	0
TOTAL NON-COMMERCIAL THINNING	**531**	**2028**	**1897**
Plantation	204	249	231
Slashing before Prescribed Fire	327	532	545
Non-commercial thinning associated with timber harvest units	1467	1306	1121
TOTAL PRESCRIBED FIRE	**3322**	**3226**	**2111**
Prescribed fire associated with commercial harvest	1476	1306	1121
Prescribed fire only	1307	943	202
Prescribed fire with non-commercial thinning	327	656	798
Total Area Treated[1]	3314	3159	2107

[1]Total Area Treated is not the sum of total commercial harvest, total non-commercial thinning, and total prescribed fire because treatments overlap between these categories. In other words, several types of treatment occur in the same units.

Rather than view conditions resulting from insects and pathogens as static and unpredictable, we should manage the land with an understanding of the processes of change, recognize the probability of its occurrence, and manage vegetation so it is resilient to insects, disease, and fire.

Alternatives 2 and 3 propose treating old growth stands. Two types of old growth are proposed for treatment, ponderosa pine and a Douglas-fir/grand fir mix.

<u>Commercial Treatments</u>

Commercial treatments include Intermediate harvest and single-tree and group selection harvest in uneven-aged management systems.

<u>Intermediate Harvest</u>

Intermediate harvests in the Como Forest Health project are improvement cuts. The objectives of improvement cuts are:

- thin the understory from below and remove potential ladder fuels
- thin the overstory from above to favor the best tree crown classes
- remove dead, dying and high risk trees to improve stand health, and recover value
- maintain desired stocking levels by VRU and provide more growing space for seral tree species
- maintain the large tree component of the overstory
- break up the homogenous and continuous horizontal and vertical structures

- reduce the presence of less fire tolerant vegetation
- create stands that have low to moderate mountain pine beetle hazard rating

Improvement cuts are similar to commercial thins except they focus on improving species composition and forest health rather than improving growth. The objective is to improve the existing stands by featuring the largest diameter classes, promoting fire-resilient stands, and reducing the number of stems, without any effort directed at regeneration (Smith 1962). Improvement cuts would thin stands by removing diseased and less desirable species. The treatment units are a mix of tree species or densely stocked second growth ponderosa pine. Changes in forest structure caused by improvement cuts would be most evident in areas with high stocking and multiple layer canopies, and less evident in areas with lower stocking. Improvement cuts in a multiple layered canopy would create a more open canopy, reduce the number of trees per acre, and keep the largest diameter trees as much as possible. We recognize that some large trees would be cut and removed. The combination of thinning from below and crown thinning is called variable-density thinning. Variable-density thinning is designed to remove trees from the understory and then progress into the overstory until the desired basal area (or other prescribed outcome) is reached. The purpose of variable density thinning is to open the canopy and favor the development of the healthiest trees. To maintain forest structure, the understory would not be eliminated. Variable density thinning reduces fuel continuity within the canopy, increases canopy base height, and reduces canopy bulk density thereby reducing crown-fire hazard.

Additionally, we expect there would be a balanced mix of shade intolerant species (ponderosa pine) and mid tolerant species (Douglas-fir). Following treatment, the units would contain a mix of diameter classes and trees would be well spaced. The long-term goal of this treatment is to maintain a range of age classes, and adjust for mortality and growth by providing space for trees to grow into different size classes. Intermediate thinning treatments, as well as single-tree selection, would favor retaining the ponderosa pine on the drier sites and Douglas-fir on the moister sites. These types of treatments have been successfully used on other areas on the Bitterroot National Forest, including Hayes Creek, Haacke Claremont, Elk Bed, Larry Bass, Sweeny, Lower West Fork, and Trapper Bunkhouse timber sales. Treatments would leave fewer trees, reduce ladder fuels and crown bulk density, and break up fuels and crown continuity. The residual trees would be larger, have thicker bark, and higher base crown heights making them more fire resistant. These tree characteristics would reduce the potential of crown fire and severe fire effects (Pollet and Omi 2002).

Within the proposed units, dead and dying trees may also be removed. Removal of some of the dead and dying trees would enhance the health of residual trees and increase the growing space, and capture the value of the material. Snags and potential snags would be retained in numbers appropriate to the habitat types to meet the needs of soil and wildlife resources.

Ponderosa Pine Old-Growth Treatments (Alternatives 2 and 3)

Ponderosa pine old-growth would be treated in a manner to retain and perpetuate old-growth characteristics in ponderosa pine. The senescent condition of many trees in old growth stands makes prospects for restoration uncertain. The potential for mechanical or fire damage during treatment could reduce the number of old trees sufficient to meet the old-growth criteria. There are no management guidelines to reference for appropriate density targets in restoration. However, historical conditions from 1900 provide reasonable density targets. Work by Covington et al. (1994) in the Southwest, and Arno et al. (1995) in the Northwest indicate that old growth ponderosa pine stands prior to 1900 had basal area densities less than 100 ft^2/ac. Densities of old growth ponderosa pine units in the Como Forest Health project area greatly exceed 100 ft^2/ac. Improvement cutting in the overstory would reduce stand basal area and the amount of Douglas-fir. Understory thinning treatments would reduce the density of saplings and poles. Though reserve basal areas of 40-60 ft^2/ac are recommended for younger forests and uneven-aged stands to ensure regeneration of ponderosa pine, higher reserve densities can be sustained in old growth stands. Site utilization is less per square foot of basal area for large trees than for small trees (Fielder and Culley 1995). In other words, it takes fewer old growth trees to create a specific forest density than smaller trees so there will be more space between the larger, older trees than the smaller ones. Diameter caps would be applied to old growth ponderosa pine units, in which trees 18" DBH or larger would not be cut. This diameter cap was chosen because in this old growth type, trees greater than 21" DBH and older than 170 years classify as an old growth tree. Retaining trees greater than 18" DBH would preserve the trees that meet the old growth criteria. Diameter caps do not necessarily protect all old trees, because old trees can be smaller than the cap. However, diameter caps assure that trees larger than the cap are retained, which would assist the development of old-growth structure.

Thinning is needed before low severity surface fire can be safely reintroduced to the old growth forests in the Como Forest Health project area. More commonly, prescribed burning will be conducted as a follow up to harvest to reduce natural fuels and those harvest-generated fuels. Reintroducing fire would be challenging in the old-growth forests because they have not experienced fire in more than 100 years (Harrington and Sackett 1992). Harrington and Sackett (1992) note that reducing decades of fuel buildup in a single burn could result in the loss of 20-50 percent old-growth trees in a stand. Current old growth ponderosa pine forests are vastly different from their pre-settlement counterparts that sustained frequent surface fire.

It is necessary to reduce leave tree damage during harvest to minimize tree mortality after harvest and prescribed burning. In restoration efforts of old growth forests, large-diameter tree mortality has been documented from basal injury caused by long-term smoldering duff mounds (Jain et al. 2012). Hartford and Frandsen (1992) found that soil temperatures in smoldering duff mounds exceeded 799°F (400°C) with temperatures above 212°F (100°C) for over 16 hours. Smoldering duff mounds can girdle the cambium. In addition, if there is sufficient damage to fine roots, which have migrated into the duff layer, the damage can lead to a weakening of the tree and create opportunities for disease or insects to ultimately kill it. Additional treatments, such as raking duff, would be needed before prescribed burning if roots are present in the duff (particularly just above the mineral soil), to prevent damage to the cambium of old growth trees. Or, prescribed burns need to be conducted when the roots are least active in late fall to early spring. Roots are most active before bud burst and through the growing season (Pregitzer 2003). Raking duff layers greater than 5 inches in depth from the base of trees and redistributing the duff may reduce mortality from prescribed burning (Covington et al. 1997). A relatively low intensity fire should be prescribed for the first underburning or the loss of a considerable number of old growth trees from root and cambial damage can occur (Covington et al. 1997).

Jain et al. (2012) recommends altering the rooting environment by reducing duff depths to force roots to grow in the mineral soil rather than in the duff. Then, the prescribed burn has to occur when the roots are not active and the tree is dormant. Prescribed fire should occur when soil temperatures range between 38 and 45 °F (early spring or late fall). Recent studies note that it takes a minimum of two years to notice root location changes from the duff to mineral soil.

If the area is large and conducting treatments around individual trees is impractical, yet minimizing tree mortality is an objective, then the introduction of fire may need to occur in multiple entries. The initial entry may just blacken the surface fuels, to enhance decomposition, and remove a portion of the duff. High levels of moisture in the duff will minimize smoldering potential. Smoldering is minimal when the lower duff holds greater than 100 percent moisture content (up to 130 percent) in protected areas. The deep duff layers may have as low as 90 percent moisture content on more exposed locations. It may take up to three burns (three consecutive years) to prepare the site for a fall or late summer prescribed fire (Jain et al. 2012).

Similar cuttings should be planned at 30-year intervals indefinitely into the future followed by compatible prescribed burning treatments. The long-term objective is to maintain the old-growth character, increase tree vigor, and reduce susceptibility to damaging insects and fire.

<u>Uneven-aged Harvest</u>

The objectives of uneven-aged harvest are:

- Remove dead, dying and high risk trees to improve stand health, and recover value
- Maintain desired stocking levels by VRU that provides for space and conditions favoring regeneration
- Maintain the large tree component of the overstory in single tree selection units
- Maintain uneven-aged structure for aesthetics, recreation, and wildlife
- Break up the homogenous and continuous horizontal and vertical structures with canopy gaps of 5-10 acres
- Emulate mixed severity fire on the landscape
- Treat mixed conifer old growth stands

Uneven-aged silviculture mimics the scattered overstory mortality in the older age classes, and establishes and develops new age classes. Ultimately, stand structure will be characterized by a diversity of vertical crown structure and cohorts. Uneven-aged stands are developed using group selection or single tree selection harvest.

Group Selection

Group Selection is used to mimic intensive, small-scale disturbances that create openings in a stand and are generally less than 5 acres in size but could be up to 10 acres. Group selection in the Como Forest Health project area is used on the north aspects and in mixed conifer old-growth units. The north aspects are multi-layered and have a mix of tree species. To maintain structure, both vertically and horizontally, without treating the whole stand, discrete groups are created in the canopy. The groups imitate "gaps-phase dynamics" where gaps (or openings) in the canopy are naturally created without departing from late-successional species composition. The gaps are not uniform and mimic openings caused by wind, fire, and diseases associated with old forests.

One form of group selection used in the Como Forest Health project area would remove Douglas-fir trees heavily infested with dwarf mistletoe. Removing these heavily infested trees reduces disease spread by reducing the infection source and increasing the space between trees. Within selected groups removal of all mistletoe trees may be prescribed. Removal of the heaviest mistletoe infections and thinning to favor tree species not affected by Douglas-fir dwarf mistletoe, such as ponderosa pine, would improve the overall health of the stand (Hadfield et al. 2000). Removing the dwarf mistletoe-infested trees creates open, growing space and support tree regeneration. The group selections would be large enough for successful seed germination and development of mistletoe-free seedlings.

Douglas-fir trees with lesser amounts of mistletoe would remain on the landscape following treatment. We recognize that eradication of dwarf mistletoe is not possible or desirable. The openings would also support grasses, forbs, and shrubs that are largely absent under canopy cover.

Another type of group selection used in the Como Forest Health project is the removal of vegetation around late-successional ponderosa pine. Individual or small groups of ponderosa pine are located in various portions of stands. This type of group selection would maintain large ponderosa pine, remove competing vegetation around them, and create space for ponderosa pine regeneration. Achieving these objectives would maintain the seral stand component and create structural diversity within the stand.

Mixed Conifer Old-Growth Treatments (Alternatives 2 and 3)

Mixed conifer old-growth units would be treated to retain and perpetuate old growth characteristics yet provide for gap-phase dynamics on the landscape as described above. These mixed conifer old-growth stands occur on moderately cool to moderately warm moist sites on north slopes or along riparian areas. They are multi-storied, have high amounts of downed woody material, and optimal numbers of snags. Group selections would maintain old-growth characteristics, mainly old, large diameter trees. In this type of old growth, Old-Growth Type Code 5, trees greater than 180 years old and larger than 17"DBH qualify as old growth trees (Table 3.3-1). Group selections would target trees less than 16" DBH. This diameter cap would assist large-tree structure development, and would assure old growth replacement trees and the retention of old-growth trees. Though larger trees would be retained, other old growth forest characteristics, such as snags, large woody debris, and structural variability, may change with treatment. These characteristics are important features in late successional forests. It is uncertain whether treating these forests would keep them in an old-growth condition.

Single Tree Selection

In single tree selection units, individual trees are selected on the basis of age, diameter, vigor, form, and species. The treatment objective would be to maintain a relatively consistent stand structure. To achieve a mosaic of even and uneven-aged stands spatially, a combination of groups may be harvested to establish ponderosa pine regeneration along with removal of single trees to balance diameter classes.

Timber Harvest followed with Prescribed Fire

Prescribed fire is a tool for periodically reducing fuels and maintaining vegetative composition and structure in the VRUs. Timber harvest before prescribed fire allows fire to be reintroduced into the project area without causing high levels of tree mortality. Reinhardt et al. (2008) suggest that a realistic approach to fuel treatments is to “focus on creating conditions in which fire can occur without devastating consequences.” This approach to fuel reduction requires achieving the final fuels objective through a series of treatments.

Timber harvest alone, without follow-up prescribed burning, does not alter wildfire behavior. Fuel loading reductions would reduce fire hazard through the combination of prescribed fire and mechanical treatments. Whole tree yarding followed by prescribed fire would reduce existing surface fuel loads and activity fuels to acceptable levels by removal, then consumption. Reducing surface fuels using prescribed fire and timber harvest lowers the risk the overstory would ignite in a wildfire (Graham et al. 2004). Reducing understory tree density and ladder fuels through slashing facilitates underburning and protects individual trees from scorch. Thinning and fuel treatments reduce fire severity and crown scorch (Pollet and Omi 2002).

Promoting regeneration of seral tree species such as ponderosa and lodgepole pine is another purpose for prescribed burning after harvest. Prescribed fire reduces accumulated duff, prepares seedbeds, and removes competing vegetation. Research shows natural regeneration of seral tree species is more prevalent on harvest and prescribed burn units then on harvested and unburned units (Jain, et al. 2012).

The season of burning differentially affects both the site and trees remaining after harvest. Spring burning is favored because smoke dispersal is generally good, treated areas with heavy fuels can be burned more safely, soil damage is minimal because forest floor and duff materials are only partially dried, spotting is reduced because surrounding areas have “greened” up, mop-up is cheaper, and it is easier to retain coarse woody debris. One disadvantage of burning in the spring is the roots of old trees and crowns of all trees are especially vulnerable to damage because they are actively growing (Fielder et al. 2007).

Fall burning better approximates natural fire because understory vegetation is cured or dormant. In the fall, more of the fuels and duff would be consumed. Greater duff reduction benefits the regeneration of ponderosa pine. However, fall burning is harder to implement because atmospheric inversions greatly limit the number of burning days. Atmospheric inversions prevent smoke from dispersing and achieving air quality standards. Burning conditions for the appropriate fire severity may also be harder to achieve because fuels are dry.

In mixed conifer forests, it may not be possible to reduce surface and ladder fuels enough to prevent transitions to crown fire. To harmonize competing management objectives, a mix of treatments such as removing canopy fuels, creating small openings, and preserving patches of trees with tighter crown spacing may be necessary. In this way, a crown fire may initiate, but would not gather momentum. The canopy gaps would constantly disrupt the crown fire and it would drop to a surface fire. If the fire weather and fuels conditions align so the fire burns back into the canopy, the fire will hit another opening and drop back to the ground (Jain et al. 2012).

We cannot change slope, aspects, general wind conditions, lightning strikes, or the time of day that a fire moves through an area. We can however modify fuels and therefore, change factors that affect fire behavior. Agee and Skinner (2005) state the fundamental principles important for fuel reduction treatments are reducing surface fuels, raising the base height to live crown, decreasing crown density, and retaining large trees of fire-resistant species.

<u>Prescribed Fire Only</u>

Prescribed fire without any timber harvest, commercial or non-commercial, would occur in different VRUs. Low severity and mixed severity burn units are proposed because it is important to restore and maintain fire as a process of change on the landscape. Prescribed fire is a valuable tool for periodically reducing fuels, and restoring and maintaining vegetation. When vegetation attributes such as species composition and structure are within the historical range, prescribed fire without any prior harvest or thinning is appropriate to maintain these attributes.

Units A, C, and D have vegetation attributes within the historic range of VRU 2. Prescribed fire only would produce a low severity burn. Current stocking levels are relatively low in these units and burning could be accomplished with minor amounts of tree mortality. Unit A was previously harvested and the two other units are fairly open with south and southeast aspects. These units are primarily ponderosa pine, have open canopies, limited and patchy ladder fuels, and fuel loads are within historic parameters. Prescribed burning is desired to reinstate ecosystem burning and restore burning cycles. Stocking levels would not appreciably change with this treatment, therefore, increased resiliency to insects and diseases would be minor. Prescribed burning would recycle nutrients into the soil where they would be available for vegetation uptake. This flush of nutrients would enhance tree growth and other metabolic functions. As long as the burn is accomplished within prescription parameters, insects and diseases should remain at endemic levels and not increase.

Research demonstrates that non-uniform, infrequent stand replacement fires were the most common in VRUs 7 and 9. Fires tended to occur as mosaics of low and mixed severity burning. Mixed severity fires typically burn in patches due to discontinuous fuels that occasionally become crown fires, particularly on ridge tops (Fischer and Bradley 1987). The objective of mixed severity fires is to break up fuel continuity, create mosaics of various size openings in the canopy, and prevent large-scale crown fires. Seasonality of the prescribed burn will determine the success of creating gaps that emulate a mixed severity burn. Mixed severity fire is the most diverse fire regime because it ranges between low severity and high severity fires (Arno et al. 2000; Hessburg and Agree 2003). The key phrase associated with this fire regime is “inconsistent and highly variable” (Arno et al. 2000).

Fuel treatments are never entirely “fireproof” and do not always serve as fire barriers. Under the right burning conditions, fires can burn through treatments or “spot” over them. But, as treatments accumulate across the landscape or are placed in strategic locations, they could greatly reduce the behavior of individual wildfires and overall fire patterns (Finney 2001).

Non-Commercial Thinning with Prescribed burning

Non-commercial thinning removes trees up to 10" DBH, depending on the site, and favors seral species. The felled trees would be lopped (cut into short sections) and scattered on the site. In some areas with heavy concentrations of slash, fuels less than 4" in diameter (mainly limbs and tops) would be piled and burned. The non-commercial thin units have scattered overstory and all trees greater than 10"DBH would be retained. The non-commercial thin units are not plantations except for units 36, 66, and 66A.

Targeted stand structure can be created more precisely with non-commercial thinning than with prescribed fire alone (van Wagtendonk 1996, Weatherspoon and Skinner 1996, Stephens 1998, Agee et al. 2000, Miller and Urban 2000) because specific trees are removed or retained. By itself, noncommercial thinning can effectively reduce the vertical fuel continuity that initiates crown fires, especially when the removal of smaller trees and shrubs is emphasized. In addition, thinning small material and pruning branches targets ladder fuels and specific components in the ladder-fuel stratum, and are more precise methods than prescribed fire alone. The net effect of removing ladder fuels is that surface fires are less likely to ignite the overstory canopy fuels. However, noncommercial thinning does little to reduce surface fuels, unless the fuels are compacted, crushed, or masticated during the thinning process. Noncommercial thinning may add to surface fuels and increase surface fire intensity unless the fine fuels are removed from the stand or otherwise treated with prescribed fire (Alexander and Yancik 1977).

Stand density in the understory would be reduced by 40-70 percent in the non-commercial thin units. Many, of these units have high densities of Douglas-fir in the pole size class. Most of the Douglas-fir trees in the understory are suppressed and not growing vigorously; they would not "release" even if they were retained. Due to high stem density in various units, these sites are experiencing high levels of competition and making the overstory susceptible to mountain pine beetle.

Unit 36, 66, and 66a are ponderosa pine plantation with current mountain pine beetle activity. After treatment, prescribed fire would be considered when beetle activity is low. Ponderosa pine trees would be thinned on a spacing that would reduce competition for water, nutrients and light, and increase growth and vigor on residual stems.

Overall, non-commercial treatments would retain trees 10"DBH and greater and no timber would be removed from the site. Non-commercial thinning would increase stand resilience to disturbance in the long term and favor shade-intolerant trees addressing shifts in species competition that have occurred at the landscape level. Non-commercial thinning would move the landscape towards the desired future condition by restoring key tree species and structure.

Cumulative Effects for Alternatives 2, 3 and 4

Long-term vegetation benefits are expected through proposed treatments and existing treatments completed around the recreation area which reduces forest stocking. Fewer trees would improve individual tree health and vigor as there would be less competition for nutrients and water. We expect insect and disease infestations would be less severe in the event of a mixed or stand replacing fire event due to treatments. However, it is difficult to predict precisely what may actually happen since many factors play into insect and disease epidemics and wild fire.

As fire is incorporated back onto the landscape from various projects near the proposed project, we would expect some bark beetle activity in trees scorched by maintenance and prescribed burning. The actual amount is difficult to determine but we expect it would be very small in scale and localized in the treatment units as long as burn prescription parameters are met.

Implementing proposed treatments within the major VRUs would allow managers flexibility to incorporate wildland fire on the landscape when those fires do occur, knowing the treated vegetation is more resilient to insect and disease infestations and fire events. Beneficial effects of these proposed treatments would be seen for approximately 10 to 20 years. Even though treatments would result in reduced stand densities and lowered risks to insect and disease infestation, vegetation growth rates would dictate when the risk level actually is reduced (Schmid et al, 1994). Reduction in stand densities would need to be an ongoing management practice in order to maintain forested conditions at a lowered susceptibility level. In the future, we anticipate that additional maintenance treatments such as, thinning and prescribed burning would be needed to maintain the historical fire interval and forest resilience to wildfire, and insect and disease infestations. Prescribed fires 6 to 10 years after the initial treatments would maintain these beneficial effects.

<u>Climate Change</u>

Recent and projected changes in climate are likely to substantially stress many forest communities and tree species (Parry et al. 2007; Soja et al. 2007; Breshears et al. 2005, Field et al. 2007). At the regional scale, warming average annual temperatures, declining mountain snowpacks, and earlier spring runoff have been noted in the Pacific Northwest, which includes western Montana (Mote 2003, Stewart et al. 2004). Future changes are less certain, though an increase in average temperatures is commonly projected (Mote et al. 2005). These climatic trends suggest that forests in the project area, particularly the drier forest types, may continue to experience increased drought stress in future decades, much as has occurred in recent past decades. As discussed at length in other portions of this chapter, this stress is exacerbated by increasing tree densities and competition for limited water, weakening the trees and increasing their susceptibility to insects and disease infestation. In addition, climate trends in the Pacific Northwest, and indeed throughout much of the western United States, suggest that the risk of high intensity wildfires would continue (Westerling et al. 2006; Running 2006), intensified by increased forest density and fuel loads.

The proposed treatments in the Como Forest Health project area are designed to improve stand health and resiliency by altering forest composition, structure, density, and fuel loads. The treatments would maintain seral tree species that are well-adapted, long-lived, and fire resistant. Reducing forest density would improve tree vigor, which would improve forest adaptability and maintain its integrity through climate changes, and associated changes in insect, disease, or fire frequency. In lieu of the ability to dramatically alter climatic trends (at least in the short term), and with the inherent uncertainty regarding what specific long-term climatic changes may be, this is one of the best options we have to maintain intact, healthy, functioning forests that can provide for a variety of future resource and social needs.

Forest Carbon

Forests mitigate the effects of greenhouse gas emissions by removing carbon from the atmosphere and sequestering it in biomass. The proposed treatments would remove some carbon currently stored within live and dead trees. A portion of the carbon removed would remain stored for a period in wood products (US EPA 2009, Depro et al 2007). Harvest of live trees could temporarily convert some stands from a carbon sink that currently removes more carbon from the atmosphere than it emits, to a carbon source that emits more carbon through biomass decomposition than it absorbs through tree growth. As stands continue to develop the strength of the carbon sink would increase until peaking at an intermediate age and then gradually decline but remain positive (Pregitzer and Euskirchen 2004). Carbon stocks would continue to accumulate, although at a declining rate, until impacted by future disturbances. Over the long-term (centuries) net carbon storage is often zero because re-growth of trees recovers the carbon lost in the disturbance and in decomposition of trees killed by the disturbance (Kashian et al. 2006).

Management actions designed to maintain or restore forests to healthy and productive conditions would help maintain carbon stocks and sequestration rates. Increases in disturbance events such as wildfires and insect outbreaks, can release large amounts of carbon to the atmosphere (short- and long-term) and reduce carbon stocks (Field et al. 2007). The potential for future disturbances (insect, disease, fire) and the expected severity of those events for the Como Forest Health project area have been disclosed in the discussion of direct and indirect effects. Birdsey et al. (2006) indicate that forest management technologies that may reduce carbon dioxide emissions or increase productivity include: nutrient management, residue management and utilization, thinning and better utilization of the resulting wood products, low-impact harvesting, and species or genotype selection. Though the proposed prescribed burning in the Como Forest Health project would reduce standing carbon stocks and result in emission of carbon to the atmosphere, it would be far less when compared to the amount of carbon that would be released during a wildfire (Finkral and Evans 2008).

Ultimately, it is not possible to specifically determine the cumulative impact on global carbon sequestration and atmospheric concentrations of carbon dioxide from the proposed Como Forest Health project activities. What is apparent is that these effects would be miniscule, particularly in the context of the 66,600 teragrams of carbon currently contained in U.S. Forests. The short-term change in carbon stocks and sequestration rates resulting from the proposed action are imperceptibly small on global and national scales, as are the potential long-term benefits.

3.1.3.4 Effects of Silvicultural Treatments that Differ Between Alternatives

This section discusses unit treatment effects that differ between alternatives. Though the silvicultural prescriptions are the same, some units are treated in one alternative but not another or the treatment changes between alternatives. For example, Unit 8 is an improvement cut in Alternative 2 and is a non-commercial thin in Alternatives 3 and 4 (Table 3.1- 6).

Alternative 2 – Proposed Action

Direct and Indirect Effects

Commercial Timber Harvest Followed by Prescribed Fire

The effects of commercial harvest followed by prescribed fire are described in the previous section, 3.1.3.3. Under Alternative 2, approximately 1,476 acres are commercially harvested and followed with prescribed fire (Table 3.1- 7). Approximately 838 acres are treated with intermediate harvests and 638 acres are treated under uneven-aged management systems (Table 3.1- 7). Most of the ponderosa pine units susceptible to mountain pine beetle are treated except for the Lick Creek research units established in the early 1990s. Growth since the 1990s has increased the density of these units to 80-120 BA (ft^2/ac) making these units vulnerable to mountain-pine beetle-caused mortality. When these units were established, the silviculturist anticipated the need for another entry at this time. Not treating this area would leave approximately 155 acres of ponderosa pine in a moderate to high hazard rating, susceptible to mountain pine beetle in the middle of the project area.

Table 3.1- 6: Unit Treatments for Each Alternative. Units are shaded that have the same treatments between alternatives.

UNIT NO.	ALTERNATIVE 2	ALTERNATIVE 3	ALTERNATIVE 4
1	Uneven-age, single tree selection	Uneven-age, single tree selection	Uneven-age, single tree selection
3[1]	Intermediate harvest	Intermediate harvest	No Treatment
4[2]	Group Selection	No Treatment	No Treatment
5[2]	Group Selection	No Treatment	No Treatment
6[2]	Group Selection	Group Selection	No Treatment
8	Intermediate Harvest	Thin from below up to 10" DBH	Thin from below up to 10" DBH
9	Intermediate Harvest	Intermediate Harvest	Intermediate Harvest
10[1]	Intermediate Harvest	Intermediate Harvest	Intermediate Harvest
11	No Treatment	Non-commercial Thin	Non-commercial Thin
12	Uneven-age, single tree selection	Uneven-age, single tree selection	Uneven-age, single tree selection
13	Non-commercial Thin	Non-commercial Thin	No Treatment
14	Non-commercial Thin	Non-commercial Thin	Non-commercial Thin
15	Intermediate Harvest	Thin from below up to 10" DBH	Intermediate Harvest
16N	Group Selection	No Treatment	No Treatment
16S	Intermediate Harvest	No Treatment	Intermediate Harvest
17	Intermediate Harvest	Intermediate Harvest	Intermediate Harvest
18	Intermediate Harvest	Intermediate Harvest	Intermediate Harvest
19	Intermediate Harvest	Intermediate Harvest	Intermediate Harvest
20	Intermediate Harvest	No Treatment	No Treatment
21	Intermediate Harvest	Intermediate Harvest	Intermediate Harvest
22[3]	No Treatment	Intermediate Harvest	Intermediate Harvest
22A[3]	No Treatment	Non-commercial Thin	Non-commercial Thin
23[3]	No Treatment	Intermediate Harvest	Intermediate Harvest
23A[3]	No Treatment	Non-commercial Thin	Non-commercial Thin
24	Non-commercial Thin	Non-commercial Thin	No Treatment

UNIT NO.	ALTERNATIVE 2	ALTERNATIVE 3	ALTERNATIVE 4
25	Intermediate Harvest	Intermediate Harvest	No Treatment
26	Intermediate Harvest	Intermediate Harvest	No Treatment
27	Intermediate Harvest	Intermediate Harvest	No Treatment
28	Intermediate Harvest	No Treatment	Intermediate Harvest
32	Intermediate Harvest	No Treatment	Intermediate Harvest
34	Intermediate Harvest	No Treatment	Intermediate Harvest
36	Non-commercial Thin	Non-commercial Thin	Non-commercial Thin
38	Group Selection	No treatment	No Treatment
39	Uneven-age, single tree selection	Uneven-age, single tree selection	Uneven-age, single tree selection
40	No Treatment	Intermediate Harvest	Intermediate Harvest
41	Group Selection	No Treatment	No Treatment
42[2]	Group Selection	Group Selection	No Treatment
43	Non-commercial thin	Non-commercial thin	Non-commercial thin
45[2]	Group Selection	Group Selection	No Treatment
46[1]	Intermediate Harvest	No Treatment	No Treatment
47[1]	Intermediate Harvest	Intermediate Harvest	No Treatment
48	Intermediate Harvest	Intermediate Harvest	Intermediate Harvest
49	Intermediate Harvest	Intermediate Harvest	Intermediate Harvest
50	Intermediate Harvest	Intermediate Harvest	Intermediate Harvest
51	Non-commercial thin	Non-commercial thin	No Treatment
52	Non-commercial thin	Non-commercial thin	No Treatment
53	Intermediate Harvest	Intermediate Harvest	Intermediate Harvest
57	Group Selection	Group Selection	No Treatment
58	Group Selection	No Treatment	No Treatment
59	Intermediate Harvest	Intermediate Harvest	Intermediate Harvest
60	Group Selection	No Treatment	No Treatment
61	Intermediate Harvest	Intermediate Harvest	Intermediate Harvest
62	Intermediate Harvest	Intermediate Harvest	Intermediate Harvest
64	Non-commercial thin	Non-commercial thin	Non-commercial thin
65	Intermediate Harvest	No Treatment	No Treatment
66	Non-commercial thin	Non-commercial thin	Non-commercial thin
66A	Non-commercial thin	Non-commercial thin	No Treatment
70	No Treatment	No Treatment	Aspen treatment
73	No Treatment	No Treatment	Aspen treatment
74	No Treatment	No Treatment	Aspen treatment
75	No Treatment	No Treatment	Aspen treatment
A	Prescribed Fire	Prescribed Fire with slashing	Prescribed Fire with slashing
B	Prescribed Fire	Prescribed Fire	No Treatment
B2	No treatment	Prescribed Fire with slashing	Prescribed Fire with slashing
C	Prescribed Fire	Prescribed Fire	Prescribed Fire
C2	Prescribed Fire	Prescribed Fire with slashing	Prescribed Fire with slashing
D	Prescribed Fire	Prescribed Fire	Prescribed Fire
E	Prescribed Fire	Prescribed Fire	No Treatment
E2	Prescribed Fire	Prescribed Fire with slashing	No Treatment
G	No Treatment	Prescribed Fire	No Treatment
H	Prescribed Fire	No Treatment	No Treatment

[1]These units are ponderosa pine old growth; only part of unit 10 is old growth and it is not treated in Alternative 4
[2]These units are mixed conifer old growth; only part of unit 42 is old growth and is not treated in Alternative 4
[3] These units are the Lick Creek Research Units

Prescribed Fire Only

The effects of using prescribed fire only in Units A, C, and D would be the same as described in the previous section, 3.1.3.3. The fuels in these units have been treated in the past and are within the historic range for their VRU. The fuels density, structure, and composition in Units B, C2, E2, and H would not be conducive to low severity burning or moderate severity burning in Unit E (Table 3.1- 7).

Table 3.1- 7: Treatment Differences Between Alternatives 2, 3, and 4 in the Como Forest Health Project.

TREATMENT	ALT. 2 (ACRES)	ALT. 3 (ACRES)	ALT. 4 (ACRES)
Commercial harvest and prescribed fire	1,476	1,292	1,115
Intermediate harvest	846	804	773
Uneven-aged management	630	488	342
Non-commercial thin and prescribed fire	531	791	742
Treats Lick Creek research units	0	174	174
Treats old growth ponderosa pine	49	35	0
Treats old growth mixed conifer	138	108	0
Treats units east of BRID ditch	76	0	76
Treats Aspen	0	0	39
Potential for prescribed fire to burn at historic severity	A, C, D[1] 275	A, B2, C, C2, D[1] 503	A, B2, C, C2, D[1] 454
Potential for prescribed fire to burn hotter than historic severity	B, C2,E, E2, H 1032	B,E, E2, G 718	None

[1]Unit D acres changes by Alternative

Units B, C2, and E2 are primarily ponderosa pine, and have greatly departed from historical ranges in structure, species composition, and fuel loads. To achieve low mortality levels, commercial treatment needs to occur first. There is less predictability in post treatment stand structure following prescribed fire without thinning because prescribed fire is not a precise tool for modifying stand structure and composition.

Unit E is within VRUs 7 and 9 and is primarily composed of Douglas-fir and lodgepole pine. The prescribed fire would be a mixed severity burn and the treatment objective would be to create vegetative mosaics on the landscape. Mixed severity fire is the most diverse fire regime because it ranges between low severity and high severity fires (Arno et al. 2000; Hessburg and Agree 2003). The amount of high severity fire in the unit could be extensive because of the low canopy base heights, dense canopy closure, and fuel loads. The season in which the area is burned would also determine the burn intensity; however under typical burning weather conditions fire severity would be hotter than desired. Vegetative mosaics diversify wildlife habitats and scenery, and reduce the probability of widespread wildfire damage on watershed values (Fischer and Bradley 1987). The vegetative mosaics create gaps causing different forest structural diversity.

In unit H, stand 77010120 (22 acres) is the only portion of this unit that could be successfully burned at low severity without modifying fuels. The stand has a southwest aspect, and current stand structure and composition in which a prescribed burn would consume the ground fuels and cause less mortality in the overstory. However, the rest of unit H would need fuels treatment before burning. This unit is even-aged, mature Douglas-fir stands, on north aspects with heavy crown closure, high stocking levels, and very little understory that could be considered ladder fuels.

Models have been developed to predict DFB impacts from prescribed burning and post-fire management after a wildfire. Models developed by Hood and Bentz (2007) predict Douglas-fir mortality and beetle attacks within 4 years post-fire in areas dominated by Douglas-fir in the Northern Rocky mountains. These models are intended to be a part of the planning process in Douglas-fir forests and managers should augment their decision criteria with information on many factors, including location of population centers of DFB, tree physiological factors, overall stand health, and management objectives (Hood and Bentz 2007). The model was used in the Douglas-fir stands and showed high rates of DFB impacts without commercially harvesting the stand first.

The Douglas-fir beetle has consistently been associated with fire-injured Douglas-fir, often attacking larger trees with moderate to high levels of bole injury (Furniss 1965; Rasmussen et al. 1996; Weatherby et al. 2001) and light to moderate levels of crown injury (Cunningham et al. 2005; Peterson and Arbaugh 1986; Ryan and Amman 1994; Weatherby et al. 2001).

Unit H surrounds a previously harvested ponderosa pine stand that is a seed production area. Fire would need to be prevented from entering this area.

Non-Commercial Thinning with Prescribed Fire

Approximately 531 acres would be non-commercially thinned followed by some form of prescribed fire. The type of prescribed fire would be determined by a post-thinning exam based on fuel loads, canopy base height, stand structure, and tree diameters. Prescribed fire type would likely be pile burning, jackpot, underburning or a combination of the three methods. Unit 36 is a ponderosa pine plantation with current mountain pine beetle activity. Mountain pine beetle activity would be monitored following thinning before prescribed fire is initiated.

Summary of Direct and Indirect Effects

Stocking levels in commercial harvest units would vary with the site capabilities and would average 50 BA. Stocking would be maintained between 40 and 60 BA. In single-tree selection, the classical basal area reduction (BD*q*) approach to stand structure regulation involves residual basal area, diameter of the largest reserve trees, and the ratio between the numbers of trees in successive diameter classes (Fielder 1995). Fielder (1995) asserts residual basal area is probably one of the most important factors for successful single-tree selection because it sets the stage for capturing the site's growth potential, allocating space for regeneration and ensuring structural sustainability. The target of 50 BA was chosen based on site capability. Group selection harvests would create a mosaic of forest density, vertically and horizontally across portions of the project area.

Group selection harvests on north aspects would emulate natural disturbance by creating openings or gaps in the forest canopy. The gaps would be created by removing mistletoe-infested Doulas-fir or reducing vegetation around large ponderosa pines. The creation of small openings can disrupt fire behavior as well. A crown fire may initiate, but it would not gather momentum when disrupted by areas of wider tree spacing and canopy gaps, and will drop back to the ground. If the fire weather and fuels conditions align for the fire to climb into the canopy, the fire would hit an opening and drop back to the ground (Jain et al. 2012)

Treatment of old growth ponderosa pine can be successful when diameter caps and prescribed burning strategies are implemented that minimize ponderosa pine mortality. Studies by Fiedler, Arno, and Covington have shown that ponderosa pine restoration is successful, especially in late successional stands. Uncharacteristic wildfire and bark beetle mortality of old-growth ponderosa pine are outcomes of not treating these stands.

Treatment of mixed conifer old-growth forest is complex and more uncertain that old growth characteristics could be maintained with treatment. Very little research has been conducted on these sites that document the success of maintaining old-growth characteristics following treatments. Snags, large woody debris, and multi-layered canopies are essential old-growth characteristics in this old growth community. Timber harvest followed with prescribed fire could reduce these characteristics below the levels that define old growth forest. These old-growth units have dense vegetation and structural variability, which provide habitat connectivity on a generally open landscape. These old growth units are well within their fire frequency intervals. The addition of group selections within these stands would hasten the spatial mosaic of variable forest densities.

The effects of the various commercial treatments would reduce the amount of shading on surface fuels, increase wind speeds and reduce relative humidity at the forest floor, increase the fuel temperature, and reduce fuel moisture. These effects may increase the probability of ignition and surface rates of fire spread, depending on weather conditions, but the reduced fuel levels and arrangement of fuels would reduce fire severity and increase opportunities for wildfire management (Peterson et al. 2005). Surface fires, even high intensity surface fires, have less potential to progress into crown fires when ladder fuels are reduced. There is a lower potential that individually torched trees would progress into a crown fire when canopy bulk density is reduced. Lower overall fireline intensity would increase options for safe wildfire management (Van Wagner 1977, Rothermel 1983, 1991).

Prescribed fire would be successful in units A, C, and D due to current stand structure, fuel loads, and fire frequency. Fuel conditions in Units B, C2, E, E2, and H would cause high levels of tree mortality and would not meet desired future conditions.

Proposed treatments would decrease the risk of ponderosa pine tree mortality from mountain pine beetle and western pine beetle infestation by reducing stocking levels on 1, 393 acres of ponderosa pine.

Alternative 3

Direct and Indirect Effects

Commercial Timber Harvest Followed by Prescribed Fire

Alternative 3 treats approximately 1,292 acres with commercial harvest, followed by prescribed fire (Table 3.1- 7). About 804 acres are treated with intermediate harvests and 488 acres are treated under uneven-aged management systems. The next phase of treatments in the Lick Creek research areas is included in this alternative. These treatments would reduce the susceptibility of the units to mountain pine beetle-caused mortality. The treatments exclude the control units from the 1990s research design so monitoring of the treatments could continue. Refer to Table 3.1- 7 for a summary of unit treatments between the alternatives.

Alternative 3 does not treat units 28, 32, and 34, east of the BRID ditch because they require the construction of system and temporary roads for access (Table 3.1- 6). These units, on and adjacent to the forest boundary have a moderate to high risk of mountain pine beetle-caused mortality. The susceptibility and likelihood of mountain pine beetle infestation will continue to increase in units without treatment. Unit 65, also east of the BRID ditch would not be treated but this unit is mostly Douglas-fir so ponderosa pine mortality from mountain pine beetle would not be as noticeable.

Units 4, 5, 15, 16N, 16S, 38, 41, and most of Unit 50 would not be harvested because they also require road construction for access (Table 3.1- 6). Units 4, 5, 16N, and 41 are mostly Douglas-fir so they would have little effect on mountain pine beetle activity in the project area. Unit 15 and the untreated portion of Unit 50 would continue to be susceptible to mountain pine beetle and its spread. The opportunity to create structure in Unit 38 would be lost in this alternative. Unit 38 is a ponderosa pine stand with little variation in structure. Regeneration of ponderosa pine could be initiated by creating small (<4 acres) openings.

Unit 8 is thinned from below but not treated commercially in Alternative 3. The unit is above Como Lake and is directly visible from the lake. Thinning the unit would reduce the crown fire potential but would not open the stand enough to reduce mountain pine beetle hazard. If the unit becomes infested, it will be visible from the lake and has the potential to infest the previous thinning treatments in the adjacent campground if the population increases.

Unit 46, an old growth mixed ponderosa pine and Douglas-fir stand is not treated under Alternative 3. This unit is above Como Lake and directly visible from the lake. This unit has a high risk of mountain pine beetle infestation and fire severity would be high if it burned.

Prescribed Fire Only

Under Alternative 3, Units B, C, D, E, and G have prescribed fire without prior thinning or slashing (Table 3.1- 6). Unit H would not be burned which is positive due to current high stand densities and structure. The effects of using prescribed fire only in Units C and D would be the same as described in the previous section, 3.1.3.3. The fuels in these units have been treated in the past and are within the historic range for their VRU.

The fuels density, structure, and composition in Units B and G would not be conducive to low severity burning or mixed severity burning in Unit E. Units B and G are primarily ponderosa pine, and have greatly departed from historical ranges in structure, species composition, and fuel loads. The effects of using prescribed fire only in these units would be the same as described for Units B, C2, and E2 in Alternative 2. The effects of using prescribed fire only in Unit E are the same as described for Unit E in Alternative 2.

Non-Commercial Thinning with Prescribed Fire

Approximately 656 acres would be non-commercially thinned followed by some form of prescribed fire (Table 3.1- 7). Prescribed fire following treatment in most of these units would be the same as described in the previous section, 3.1.3.3. Burn Units A, B2, C2, and

E2 would be non-commercially thinned prior to the prescribed fire under this alternative. The understory fuels in Units A, B2, and C2 would be modified to burn at the appropriate fire severity. Unit E2 is a dense stand of ponderosa pine. Thinning the understory would remove ladder fuels but would not reduce stand density. This unit would likely have higher levels of scorch and subsequent bark beetle-caused mortality.

The understory in Unit 8, adjacent to Three Frogs campground, would be non-commercially thinned under Alternatives 3 and 4 but stand density would be over 120 BA. Though the ladder fuels would be removed, which would inhibit potential crown fire, the stand would be susceptible to mountain pine beetle infestation. An infestation in this unit could spread into the area around the campground though it was thinned in 2012. In Alternative 2, the unit would have a commercial thin using variable thinning, which would complement the 2012 campground treatment.

The type of prescribed fire in these units would be determined by a post-thinning exam based on fuel loads, canopy base height, stand structure, and tree diameters. Prescribed fire type would likely be pile burning, jackpot, underburning or a combination of the three methods.

Non-Commercial Thinning without Prescribed burning

Units 66 and 66a are young plantations that would be thinned. Thinning would provide additional growing space to enhance stand development. Prescribed fire is not needed at this time because the trees have not developed enough fire resistance. Thinning slash would be lopped and scattered or piled and burned at the plantation boundaries.

<u>Summary Effects</u>

Alternative 3 reduces susceptibility to mountain pine beetle by treating approximately 1,373 acres of ponderosa pine. However, some key ponderosa pine units are not treated, which may reduce the total landscape effect. Ponderosa pine units east of the BRID ditch would not be treated under this alternative and increasing levels of mountain pine beetle mortality would be expected. Unit 28 is next to the National Forest boundary. High fuel loads in this unit would increase the difficulty of managing wildfire and preventing its spread onto private land.

Thinning the understory in Unit 8 would reduce ladder fuels but would not reduce susceptibility to mountain pine beetle infestation because the BA in the unit would remain moderate to high. The understory thinning alone would not reduce potential mountain pine beetle-caused mortality.

The old growth, ponderosa pine unit 46 would be vulnerable to increasing mountain pine beetle-caused mortality and at high risk of high severity fire. The unit would likely revert to stand initiation if mountain pine beetle infestation is followed by high severity fire and the old growth characteristics would be lost for the next 170 years.

Old growth, mixed conifer units 4 and 5 are not treated in Alternative 3 because they require track line-machine trails to access them. The old growth characteristics in these units would continue to develop through the interaction of natural disturbances.

Prescribed fire would be successful in units A, C and D due to current stand structure, fuel loads and fire frequency. Units B2 and C2, would be successful with the additional non-commercial thinning treatment prior to underburning. Though understory thinning prior to burning would reduce ladder fuels, the stand density would remain high and Unit E2 would sustain higher levels of tree mortality from both prescribed fire and mountain pine beetle.

Units B, G, and E would result in high stand mortalities and would not meet desired future conditions.

Proposed treatments would decrease the risk of ponderosa pine tree mortality from mountain pine beetle and western pine beetle infestation by reducing stocking levels but not across the project area. Areas susceptible to mountain pine beetle infestation would remain, specifically in units 8, 28, 32, 34, 46, and part of unit 50.

Alternative 4

Direct and Indirect Effects

Aspen Treatments

The objective is to improve existing aspen stands in units 70, 73, 74, and 75 by featuring aspen and removing conifers within the clones and 50 feet outside the clones (Table 3.1-6). Prescribed fire would be allowed to creep through Units 73 and 74 but fire would not be ignited in Units 70 and 75.

Aspen clones occur as a component within the conifer dominated landscape of Como Forest Health project area. Most aspen clones are seral and can be replaced entirely by conifers without a periodic disturbance to kill old stems and trigger regeneration of new ramets (Sheppard, 1996). Aspen will generally be replaced by conifers as the shade prevents suckering. Regeneration in aspen requires a disturbance that interrupts the balance between the roots and shoots causing stimulation of root buds (suckering). Disturbance can be caused by fire, disease, timber harvest, or temporal disturbance such as defoliation. To sucker, aspen require openings relatively free of an overstory canopy so sunlight can penetrate directly to the forest floor and warm the soil. The treatments would promote aspen regeneration to enhance age and size class distribution. The proposed treatments of removing competing conifers and prescribed burning the units, except unit 70 and 75, would re-invigorate clones and maintain vegetative diversity across the landscape.

Commercial Timber Harvest Followed by Prescribed Fire

The effects of commercial harvest followed by prescribed fire are described in the previous section, 3.1.3.3. Alternative 4 treats approximately 1,121 acres of ponderosa pine with commercial harvest, followed by prescribed fire (Table 3.1- 7). About 768 acres are treated with intermediate harvests and 342 acres are treated under uneven-aged management systems (Table 3.1- 7). The next phase of treatments in the Lick Creek research areas is included in this alternative. These treatments would reduce the susceptibility of the units to mountain pine beetle-caused mortality. The treatments exclude the control units from the 1990s research design so monitoring of the 1990 research treatments could continue. This alternative does not treat in old growth units or units with potential wildlife cover. Refer to Table 3.1- 3 for a summary of unit treatments between the alternatives.

Alternative 4 treats units 28, 32, and 34, east of the BRID ditch and the effects of this treatment would be the same as in Alternative 2 (Table 3.1- 6). These units, on and adjacent to the forest boundary have a moderate to high risk rating for mountain pine beetle. Unit 65, also east of the BRID ditch would not be treated but this unit is mostly

Douglas-fir so ponderosa pine mortality from mountain pine beetle would not be as noticeable.

Most of the units not treated are Douglas-fir or mixed conifer forest that provides wildlife cover. Not treating these units would have no effect on mountain pine beetle population growth potential as many of the ponderosa pine in these units are dead from mountain pine beetle. However, Unit 57 has an almost even mix of Douglas-fir and ponderosa pine. harvesting mistletoe-infested Douglas-fir by creating small (<4 acres) openings would allow ponderosa pine regeneration sites and decrease the level of dwarf mistletoe in the stand.

Units 26 and 27 are ponderosa pine units that would not be treated because they provide cover adjacent to roads and the private land boundary. These units have a moderate to high risk rating for mountain pine beetle and increasing levels of mountain pine beetle mortality would be expected. Unit 38 would not be treated because it provides cover adjacent to the salt lick.

Units 46 and 47 are old growth mixed ponderosa pine and Douglas-fir stands that would not be treated under Alternative 4. These units are above Como Lake and directly visible from the lake. They have a high risk of mountain pine beetle infestation and fire severity would be high if they burned.

Prescribed Fire Only

Units C and D are the only units that would have a prescribed fire without pre-treatment of fuels. The stand and fuels attributes are within the historic range of VRU 2, and would burn at low severity. Current stocking levels are relatively low in these units and burning could be accomplished with minor amounts of tree mortality.

Non-Commercial Thinning with Prescribed Burning

Conifers would be removed from aspen clones in this alternative to reinvigorate the clone, expand its presence in the project area, and provide wildlife habitat. Unit 8 is a mix of ponderosa pine and Douglas-fir. Most of the unit is comprised of trees greater than 12” DBH. There is a moderate amount number of trees under 7” DBH. Thinning this unit reduces the understory density but does not decrease the overall stand density. Stand density following thinning would be over 120 BA primarily in ponderosa pine, which would be susceptible to mountain pine beetle infestation. The understory thin would reduce ladder fuels and the potential for crown fire.

The effects of thinning understory fuels in burn units A, B2, and C2 would be the same as described in Alternative 3. Units B, most of D, E, E2, and H would not be burned under this alternative.

Summary of Effects

Alternative 4 reduces susceptibility to mountain pine beetle by treating approximately 1,352 acres of ponderosa pine, acres.

Old-growth ponderosa pine forests would not be treated in this alternative. Not treating the old-growth ponderosa pine could increase wildfire severity and cause the loss of this late successional stage. The units would remain at moderate to high hazard risk of mountain pine beetle infestation.

Characteristics important to late successional forests within the Douglas-fir and grand fir old-growth forest would be retained, such as snags, large woody debris, and structural variability. These old growth units are well within their fire frequency intervals and are currently not at risk to insect and disease. The uncertainties of being able to maintain old-growth characteristics during treatment would be removed since they are not being treated.

Prescribed fire would be successful in units C and D due to current stand structure, fuel loads and fire frequency. Units B2 and C2 would be successful with the additional non-commercial thinning treatment prior to under burning.

Units B, E2, H, and G are not treated in Alternative 4. Unit B was logged in the early 1990s. The understory is presently a mix of Douglas-fir with a small amount of ponderosa pine in a sapling to small pole size class. This unit provides structural diversity that is not common in many units. There is low risk of mountain pine beetle infestation. Prescribed fire would eliminate most of the understory.

Proposed treatments would decrease the risk of ponderosa pine tree mortality from mountain pine beetle and western pine beetle infestation by reducing stocking levels. Alternative 4 meets the purpose and need.

3.1.3.5 Connected Actions, Past, Present, and Foreseeable Activities Relevant to Cumulative Effects Analysis for Alternatives 2, 3, and 4

Past, present and reasonably foreseeable actions within the Como Forest Health protection area were considered and analyzed to determine the potential for cumulative effects. Past harvest activities are listed by sale name where known. The information is based primarily on historic timber sale records and the FACTS database.

Past Timber Harvest

Clearcut, shelterwood, or seed tree harvests since the 1900s created openings in the forested vegetation (Table 3.1- 8). These openings were then planted with a desired species, such as ponderosa pine, Douglas-fir, and lodgepole pine. Current reforestation methods have evolved to hand planting with specific micro-sites and using local seed.

Table 3.1- 8: Past Timber Harvest in the Como Forest Health Project Area (Source: TSMRS database).

HARVEST TREATMENT (ACRES)	1900	1950	1960	1970	1980	1990	2000	2010
EVEN-AGE SYSTEM								
Shelterwood Establishment	95		66	40		16		
2-age Shelterwood						61		
Shelterwood Removal	46							
Seed Tree Cut				20	21			
Clearcut	146				87			
Clearcut with leave trees					59			
INTERMEDIATE HARVEST								
Commercial Thin						254	72	
Liberation Cut		117	515	145	278			
Improvement Cut						27		10
Sanitation-Salvage				167	202	196		

HARVEST TREATMENT (ACRES)	1900	1950	1960	1970	1980	1990	2000	2010
Special Cut						14		
UNEVEN-AGE SYSTEM								
Single Tree Selection			726		77	299		60
Group Selection				61		3		

Shelterwood, clearcut, and seed tree silvicultural methods in the project area reduced forest homogeneity on the landscape by adding disturbance to the system. These treatments increased age class and species diversity by establishing young, shade intolerant stands. Dozers were used to pile slash and the units and piles were burned and later planted. Dozer piling removed topsoil, nutrients, and coarse wood from the site. Dozers are no longer used to pile slash.

Small tree plantations are stocked with young, healthy seedlings and saplings. These plantations are the primary contributor to the age, size class, and species diversity in the project area. Where regeneration harvest has occurred, these sites have regenerated to the desired species and stocking levels from locally adapted seed. The action alternatives continue the next phase of treatments previously implemented to maintain the fuels within their historic ranges and maintain healthy, vigorous stands. Combined with past treatments and treatments in adjoining watersheds, these alternatives would increase productivity, vigor, and resilience on a greater landscape scale. Alternative 1 does not accomplish this.

The understory in Unit 8, adjacent to Three Frogs campground, would be non-commercially thinned under Alternatives 3 and 4 but stand density would be over 120 BA. Though the ladder fuels would be removed, which would inhibit potential crown fire, the stand would be susceptible to mountain pine beetle infestation. An infestation in this unit could spread into the area around the campground though it was thinned in 2012. In Alternative 2, the unit would have a commercial thin using variable thinning, which would complement the 2012 campground treatment.

Past Planting, Site Preparation, Natural Regeneration, Prescribed burning, and Timber Stand Improvement Activities

Post sale activities include prescribed burning, site preparation, planting, and timber stand improvement treatments such as slashing, release, or non-commercial thinning (Table 3.1-7). Generally, reforestation treatments beginning in the 1960s followed harvest activities on the same ground (Table 3.1- 9). In some cases planting followed immediately after harvest while in others, there was a time lag. In some areas, site preparation and planting activities successfully established regeneration before it could be outcompeted by in-growth of shrubs, herbaceous plants, or non-desirable trees. Non-commercial thinning followed in 10 to 20 years and reduced the competition between trees, increased growth, and enhanced the development of commercial forests.

Table 3.1- 9: Past Planting and Timber Stand Improvement Activities-1960-2010.

TREATMENT	1960	1970	1980	1990	2000
Planting	44	474	467	19	0
TSI	2,154	7	1,157	198	328

Timber stand improvement usually occurred within the managed stands and consisted of spacing the desired trees, and lopping the thinned or slashed material. In more visually sensitive areas, the thinned material may have been piled and burned. Currently, the follow-up timber stand improvement of non-commercial thinning is difficult to accomplish due to budgetary constraints that creates a backlog of vegetative treatment needs.

More recently, management focus has shifted from one of growth and yield to a desired condition reflective of the treatment objective. Within timber stand improvement projects this shift focuses on thinning the small diameter trees (ladder fuels), and reducing timber harvest created slash but keeping enough wood in the soil to replace nutrients. Thus, enough woody material is on the ground after treatment, such that follow-up burning is successful. Prescribed fire burns activity fuels or reduces natural fuels to their historic levels.